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DIFFICULTIES OF THE EVOLUTION THEORY

"DEPUIS cinquante ans les manuels sont une simple illustration du transformisme, ne mettant en lumière que ce qui lui est favorable, passant sous silence tout ce qui est en dehors de lui ou contre lui. Aussi la formation des organismes les plus compliqués est-elle considerée comme une problème simple, que les moins compétents croient comprendre et résoudre aisément en se basant sur de grossières apparences ou sur de simples rapprochements fonctionels sans valeur."

L. VIALLETON.

DIFFICULTIES OF THE EVOLUTION THEORY

BY

DOUGLAS DEWAR

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1931

BY THE SAME AUTHOR

ANIMALS OF NO IMPORTANCE
THE INDIAN CROW: HIS BOOK
BOMBAY DUCKS
BIRDS OF THE PLAINS
INDIAN BIRDS
JUNGLE FOLK
GLIMPSES OF INDIAN BIRDS
BIRDS OF THE INDIAN HILLS
A BIRD CALENDAR FOR NORTHERN INDIA
IN THE DAYS OF THE COMPANY
A HANDBOOK TO THE ENGLISH PRE-MUTINY RECORDS IN THE UNITED PROVINCES OF AGRA AND OUDH
BIRDS OF AN INDIAN VILLAGE
WILD BEASTS OF AN INDIAN VILLAGE
BYGONE DAYS IN INDIA
HIMALAYAN AND KASHMIRI BIRDS
THE COMMON BIRDS OF INDIA
BIRDS AT THE NEST
INDIAN BIRD LIFE
INDIAN BIRDS' NESTS
GAME BIRDS

In collaboration with Frank Finn

THE MAKING OF SPECIES

In collaboration with R. G. Wright

THE DUCKS OF INDIA

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PREFACE

Few people realize what a vast amount of research work is being carried out by expert biologists, the great majority of whom concentrate on some particular animal, plant, tissue or organ. These biological pioneers are usually content to add their contributions to knowledge and leave it to others to inquire into the theoretical significance of their discoveries. Some idea of the rapid growth of biological knowledge may be gathered from the fact that in the field of zoology alone some ten thousand papers are published annually, in most of which new discoveries are recorded. To these must be added the contributions of botanists, palæontologists, histologists, physiologists and anatomists. So numerous are the records of biological discoveries that no man, even if well acquainted with the dozen languages in which they are written, can possibly keep abreast with them.

Many of the new facts that have been brought to light of recent years are difficult, if not impossible, to reconcile with the Darwinian conception of evolution; in consequence this theory has undergone considerable modification. Even so, many facts remain apparently incompatible with the theory in its most modified form, and it would seem that the evolution theory may have to be supplemented by some other theory.

In the present work a few of these facts are considered.

D. D.

February 1931.

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GEOLOGICAL TIME-TABLE

Era.	Period.		Percentage of Time.
Cenozoic	Quaternary	Pleistocene Epoch	4·4
	Tertiary	Pliocene Epoch	
		Miocene Epoch	
		Oligocene Epoch	
		Eocene Epoch	
Mesozoic	Cretaceous		13·4
	Jurassic		
	Triassic		
Palæozoic	Permian		27·8
	Devonian		
	Silurian		
	Ordovician		
	Cambrian		
Protozoic			15·0
Archæozoic			39·4
			100·0

The actual duration of these periods is not known. The estimates of the duration of the Quaternary vary from 300,000 to 1,000,000 years, those of the Tertiary from 3 to 55 million years, of the Mesozoic from 5 to 165 million and of the Palæozoic from 20 to 330 million years. The larger estimates are now generally accepted.

DIFFICULTIES OF THE EVOLUTION THEORY

I

INTRODUCTION

Evolution is a philosophical conception that has always appealed to the human mind because it seems to solve the problem of the universe.

Nevertheless for centuries the majority of men of science refused to have anything to do with evolution because they could find no natural force or forces capable of effecting it.

Then, as regards the organic world, Darwin and Wallace demonstrated that there is at work in nature a natural selection which is capable of producing new species, just as the human breeder produces new breeds.

If then, asked Darwin and Wallace, new species have thus originated in nature, does the process stop there, in course of time do not new genera, families, orders, classes and phyla arise, nay more, are not all plants and animals descended from some one prototype?

They admitted that the results obtained by the human breeder have been comparatively meagre, but, said they, it is unreasonable to expect breeders who have been at work for but a century or two to produce effects comparable to those of natural selection which has been operating for millions of years.

The originator of a new theory is invariably an enthusiast; it is therefore not surprising that Darwin and Wallace answered the above question in the affirmative.

The proper attitude of the other biologists *vis-à-vis* this hypothesis would have been: we admit that your theory is both plausible and seductive and offers considerable scope for inquiry, but until we have proof of its correctness, it must remain a mere hypothesis. Until it be proved by a genealogical series of fossils that the descendants of an organism A. have in course of time become so modified that one of them must be deemed to be a new genus, we decline to admit that new genera have originated in the past by a process of evolution. We decline to admit that any organism has become transformed into another type of organism until this is proved by fossils or by experiment.

This, however, was not the attitude of many biologists of Darwin's day. These allowed themselves to be dominated by the philosophical conception of evolution. They gave the hypothesis a warm welcome and set themselves to seek evidence in its favour. The fossils known at the time seemed favourable to it. Thus, vertebrates do not occur in the earliest fossil-bearing layers of the earth's crust; they appear in the Silurian in fish-like forms. Later the amphibia show themselves, then the reptiles, and finally the birds and mammals. This is in accord with the evolution theory, although the late appearance of a form does not necessarily mean that it arose from some earlier organism by a process of evolution, for example, that fish evolved from some invertebrate. The discovery of Archæopteryx and of early fossil horses having four toes on each foot, and later horses of which each foot exhibited three toes, were in accord with the demands of the evolution theory. Moreover, Huxley and others for a time believed that *Bathybius* actually bridged the gap between living and non-living matter. Then Haeckel enunciated the biogenetic law: the individual in the course of its embryonic development recapitulates the stages through which its ancestors have passed. In support of this are such facts as the existence, at an early stage of the development of the embryo of every higher animal, of visceral arches and pouches which were believed to represent the gills and gill-clefts of fish ancestors. Further, the existence of vestigial organs in adult animals, many morphological facts and the peculiarities of geographical distribution of animals and plants, all appeared to favour the theory of evolution.

This being so, it is not surprising that the hypothesis became generally accepted by biologists. It was perhaps but natural that they in their enthusiasm should regard the theory not merely as a most useful working hypothesis but as a law of nature. In the eighties of last century we find the President of the American Association, Professor Marsh, saying: "I need offer no argument for evolution, since to doubt evolution is to doubt science, and science is only another name for truth."

After the adoption of this attitude an evolutionary interpretation was put on every new discovery. Facts that did not appear to fit in with the theory were regarded as puzzles that would eventually be solved.

Nor were men of science content to limit the processes of evolution to the organic world. Those given to generalizing made evolution all-embracing. Such extended the process to the formation of suns and planets from nebulæ, the assumption by the earth of its present form, the physical changes the earth has undergone, the origin of living from non-living matter and that of every new organism by descent with modification.

All the above changes cannot have been brought about by the same force or forces. Evolution in the inorganic universe consists of the continual dissipation of the solid substance of the universe; we are told that a time will come when all matter will have been dissipated into heat.

In the organic world evolution is a process in the reverse direction, the capture by living matter of heat and other forms of energy and the conversion of this into complex organisms.

It is now generally recognized that natural selection is incapable of accounting for the origin of entirely new organs, the assumption that the effects of use and disuse are inherited is challenged, bathybius is now known to be mere inorganic matter, the biogenetic law is not accepted by the majority of biologists, many of the fossils discovered since Darwin's time are not in accordance with expectations, numerous facts have come to light difficult to reconcile with the doctrine.

Most biologists are specialists who work within very restricted limits. They have no time for speculation. They are told by those who generalize that organic evolution is a law of nature; they accept this statement and endeavour to bring their discoveries into line with it.

In view of these facts the time seems ripe for taking stock of the present state of biological knowledge with a view to ascertaining the extent to which this coincides with the philosophic conception which at present dominates the science.

Before considering some of the facts difficult to reconcile with the doctrine of organic evolution a few words on the rival doctrine of special creation appear to be necessary, as this seems to be generally misunderstood.

As the world, which now teems with life in almost infinite variety, was formerly devoid of life, every kind of living organism must have originated by one or other of two processes—evolution or special creation.

The doctrine that any given organism arose as the result of evolution entails the belief that it developed gradually from some pre-existing organism.

The doctrine that a given organism was specially created involves the belief that it had an abrupt or sudden origin, that it sprang into existence endowed with all its essential characters.

Either belief may be held independently of any theory as to the means by which the evolution or creation has been effected.

The two doctrines are not necessarily antagonistic, in the sense that one excludes the other. It may be held that each kingdom originated is an independent creation, or that each phylum, or class, or order, or family, or genus, is an independent creation, which may have undergone differentiation or evolution since its origin.

Many theories of evolution and many of creation are possible.

The evolutionist may hold that evolution is the result of fortuitous variations in individuals, or of the power of the genes to acquire new characters; or that to evolve is a property of living matter, either inherent in it or imparted by a Creator, or that there is in protoplasm an indwelling spirit which impels it to evolve, or that living matter is mere plastic material which evolves as the result of the action of forces external to itself, and so on.

The creationist may hold that each creation is the embodiment of a divine idea, or that organisms have been created out of nothing by the mere fiat of the Creator, or that each organism arose in consequence of the rearrangement of the structural elements of some earlier organism, or of a change in the development of some embryo, and so on.

A creation is that which has been created. In the widest meaning of the term a kitten born of a cat is a creation, as is an animal that evolved gradually from a different animal as the result of slight changes in successive generations.

In order to eliminate cases such as the above and to prevent creation covering evolution it is desirable to use the term special creation. A special creation, then, is a new kind of organism which has had an abrupt origin or made a sudden appearance, as distinguished from a new kind of organism resulting from the gradual transformation through successive generations of some earlier organism.

It is sometimes said that to entertain the theory of creation is to stifle scientific inquiry. This is not necessarily the case. The scientific evolutionist seeks to discover the forces which have brought about evolution, the scientific creationist seeks to discover the methods by which creation has been effected.

The belief in a Personal Creator does not necessarily imply that His methods are capricious. On the contrary, there is every reason to believe that both inorganic and organic nature are governed by fixed "laws." If the universe be the handiwork of a Creator, He appears to proceed in an orderly manner, His method of creating new organisms being to make use of the matter He has created and the forces that emanate from Him. Thus, both the evolutionist and creationist have the same aim, that of trying to discover the material out of which new organisms are made and the forces that have operated on this material. It is submitted that the correct scientific attitude is to assume neither the sudden nor the gradual origin of new organisms, but to retain an open mind on the subject and to try to discover the mode of origin.

What does tend to stifle inquiry is to be committed to one or other of the possible methods of origin.

II

THE CHANGES IN ORGANISMS EFFECTED BY BREEDERS[1]

Breeders, by taking advantage of the phenomena of variation and heredity, have produced the various races of domesticated animals and cultivated plants.

Darwin made the results of breeding operations one of the mainstays of his theory. He pointed out that some of our domestic breeds differ from the wild form to such an extent that, if met with in a state of nature, they would be considered new species, or, in a few cases, new genera. Of pigeons he wrote (*Origin of Species*, 6th ed., p. 17): "I do not believe that any ornithologist would place the English carrier, the short-faced tumbler, the runt, the barb, the pouter and the fantail in the same genus." Had Darwin been content to apply his theory of evolution to the origin of new species and genera, the operations of breeders would have afforded strong experimental evidence of its correctness.

These operations, however, seem to tell against the evolution theory, because breeders, although they have been at work for hundreds of years, have not yet been able to produce a new breed which can possibly be deemed to belong to a new family.

All the breeds derived from a common stock, no matter how much they differ from one another in appearance, are fertile when bred *inter se*, and all clearly bear the stamp of their ancestral form; all the breeds of pigeons are clearly pigeons, all those of horses plainly horses, all those of dogs undeniably dogs. The animals themselves appreciate this; a puppy of any breed at once recognizes an individual of any other breed of dog as one of his own kind.

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[1] Those not versed in zoology are advised, before reading further, to peruse the Note on Classification (see p. 159).

That breeders have not been able to produce a breed which does not present every one of the features that characterize the zoological family to which it belongs, seems to indicate that the extent to which any organism can be changed by degrees is strictly limited.

The question naturally arises: As all the efforts of breeders have resulted only in minor changes in animals and plants, is it likely that natural selection or any other natural force can effect greater changes?

To this question three answers have been given by evolutionists. The first is: "Yes. The breeder has been at work for only a few centuries, while the forces that bring about evolution have been operating for many millions of years. It stands to reason that the breeder in so short a time cannot accomplish that which has been effected by natural causes since living matter originated."

This would be an effective reply, but for the fact that *the breeder*, no matter on what animal or plant he experiments, *after he has effected a number of minor changes in any given direction, is suddenly brought to a standstill*; in a comparatively short time he reaches a stage at which he cannot accomplish more, no matter how much he try.

It may safely be asserted that none of the existing breeds of animals or plants will ever undergo extensive developments in the directions in which they have already been changed; any changes made in them will be in other directions.

The fact that breeders are invariably brought to a standstill, no matter on what animal or plant they operate, or in what direction, is fatal to the evolution theory as enunciated by Darwin and developed by his successors, unless it can be explained away.

The second and third of the answers to the question asked above are ingenious attempts at this.

The second answer—that of de Vries and the other mutationists—is: the breeder has been unable to achieve the same results as nature, because evolution—the gradual transformation of organisms—is the result of the accumulation, not of minute variations, but of mutations or saltations that occur only periodically. During the comparatively short time at which breeders have been at work no big mutation has arisen in any of the organisms on which they have been operating. In support of this view is the fact that "sports" or mutations do occasionally crop up in animals and plants; when these occur breeders sometimes make use of them. The turnspit dog, the ancon sheep, blue and yellow budgerigars and the Shirley poppy are all breeds that were produced suddenly as the result of a sport or mutation.

This answer is no more satisfactory than the first, because, although some "sports" differ considerably from the normal type, no sport is known that differs fundamentally in any feature from the normal type. A shortening of the limbs, or a change in colour of the plumage, even though considerable, is but a superficial change, one of degree, not of kind.

Thus, the obvious rejoinder to this explanation is: "Until a sport appears differing fundamentally from the type, the theory that evolution is the result of the accumulation of mutations is pure hypothesis. Moreover, a sport differing fundamentally from its type would appear to be a special creation."

The third answer to the question is more subtle than either of the others, although it is at least as old as Epicurus. It is that the breeder has failed where nature has succeeded, because he has been operating on unsuitable material, namely on species the evolutionary tendencies or powers of which are nearly exhausted.

The evolution of those who give this answer is very different from the evolution of Darwin, Haeckel and other biologists of the last century. The evolution of the former is change by fits and starts, evolutionary outbursts after long periods of stagnation; that of the latter is slow, stately, ceaseless change.

This modern view of evolution is thus set forth by L. Cuénot [*L'Adaptation* (1925), p. 374]:

> "We are then led to believe that the evolutionary outburst (*élan evolutif*) has been the appanage of a series of rare forms, of small range, which have disappeared without leaving relics, after having exhausted their potentiality of variation in giving rise to the ancestors of the great natural groups; the ramification of the mammalian tree, to continue the simile, seems to have been complete by the middle of the Tertiary, the axis and petioles have dried up irrevocably; only a certain number of leaves are still green and fully alive, many others have dried up for ever. The green leaves are still capable of evolution and producing secondary leaflets, but no new group can appear, the evolutionary sap no longer circulates. The best proof of this is that new families have not been formed for millions of years (the estimate of the duration of the Tertiary period as three millions is too low); all existing mammals belong to specialized groups, from which it is inconceivable that they should emerge. The same applies to many other orders of the animal kingdom: incontestably the evolution of reptiles, birds, amphibians, fishes, echinoderms, molluscs, crustaceans, sponges has completely finished; they may still produce species and new genera,

but they have not within them undifferentiated material capable of evolving into unexpected forms and new mechanisms; they exhausted their evolutionary creative potentialities during the Secondary and Tertiary periods.

I do not mean by this that evolution has definitely ended on the earth, and that we know all the possible formulæ of life. . . . I readily believe that there is still a reserve capable of giving rise to new beings quite unlike any that existed formerly, or exist to-day. I look for these in microscopic families of uncertain affinity, disregarded by almost all zoological treatises, marine or freshwater organisms such as the Echiuroidea, Tardigrades, Dinoflagellates, Archiannelids, Rhodope, terrestrial forms such as the Myrientomata."

The above passage is a masterpiece. Darwin himself could not have done better. Its full significance may perhaps not be fully appreciated by some readers until after they have perused this book.

The hypothesis of Cuénot is designed to meet most of the serious objections to the evolution doctrine: the meagre results obtained by breeders, the absence of nascent organs and structures in animals, the lack of fossils testifying to the gradual origin of peculiar types, and the fact that the animals on oceanic islands all belong to families that occur on the mainland and the plants to mainland natural orders.

There is, however, not an iota of positive evidence in support of this hypothesis and Cuénot makes no attempt to point to any natural forces capable of bringing about this strange kind of evolution.

A theory of this nature cannot be disproved, but there is evidence which casts strong suspicion on it.

According to the hypothesis, the older the group, i.e. the longer it has lived on the earth, the more complete should be the drying up of its evolutionary sap. Now, the fishes appear on the Earth in the Silurian, while mammals first occur in the Trias, in other words, fishes have existed on the earth fully twice as long as mammals. As, according to Cuénot, the evolutionary sap has dried up in the mammals to such an extent that the breeder cannot produce a new genus of mammals, he ought not to be able to effect any appreciable change in the far more ancient fish. As a matter of fact, fish appear to be quite as plastic as mammals and birds. The only species of fish on which the breeder has operated extensively is the Crucian Carp of Asia; as the result of these operations all the breeds of goldfish have been produced. These differ from one another and from the ancestral form quite as markedly as do the breeds of dogs and pigeons. The retriever, spaniel, greyhound, St. Bernard, foxhound, dachshund, toy terrier and Dalmatian do not differ one from the other more than do the following breeds of goldfish: telescope, nymph, fantail, celestial, fringe-tail, lion-head, veil-tail, oranda and comet.

If Professor Cuénot wishes to establish his hypothesis he should breed a new family from one of the organisms in which he supposes the evolutionary sap still to flow. Similarly, the mutationists should breed a new family by selecting suitable mutations.

Until one or the other effects this, the proper course is, provisionally at any rate, to put a simple rather than a far-fetched interpretation on the results of breeding operations. Breeders and fanciers should be regarded as witnesses hostile to evolution.

III

THE GEOGRAPHICAL DISTRIBUTION OF ANIMALS AND PLANTS

It has been said that, whereas the peculiar geographical distribution of animals and plants is difficult to account for on the creation theory, it is readily explained on the evolution theory.

The first part of the statement may be true, but the second is open to question.

The features of the geographical distribution of animals and plants usually cited as affording the strongest support to the doctrine of evolution are:—

1. There is not a single mammal common to Europe and Australia or South America.

2. There are no mammals, other than bats, and very few land reptiles and amphibians indigenous to any oceanic island.

3. A large percentage of species and genera of plants and animals indigenous to oceanic islands are peculiar to them, i.e. do not occur elsewhere.

The absence of mammals common to Europe on the one hand and South America and Australia on the other is not due to differences of climate; the rabbit and other European animals introduced into Australia have thriven greatly.

For this reason it is said that the absence of placental mammals from Australia is difficult to account for on the theory of creation but easily explained on that of evolution. In point of fact the creationist is able to give the most satisfactory reply to the question: why are there no placentals, other than bats, indigenous to Australia? His answer is that marsupials and monotremes cannot live in competition with placentals, for this reason none of the latter were created in Australia, which thus serves as a sanctuary for the lower mammals.

This answer is in accord with the known fossils.

The answers to the question given by the evolutionists are not in accord with the fossils.

In order that the non-zoological reader may appreciate these answers it is desirable to state that at the present time the marsupials or pouched mammals occur only in America and Australasia. In the former they are represented by the opossums and the little shrew-like *Cænolestes*. In Australia they exhibit great diversity; indeed, all the indigenous mammals of that country, except the monotremes (duck-billed platypus and echidna) and a few bats, are marsupials.

The curious distribution of the marsupials and the absence of placentals from Australia is usually explained by evolutionists as follows:

Marsupials are more primitive than the placentals (to which group all the mammals of Africa and Asia and most of those of America belong) and evolved before them. For a time they overran the earth, but the placentals, after they evolved, thanks to their superior intelligence and better equipment, ousted the marsupials and drove them into remote parts of the earth, that is, into the great forests of America and into Australia, which is believed to have been at one time joined to Asia. Before the placentals reached Australia, this became cut off from Asia, so that the marsupials, free from attack by the placentals, flourished there and blossomed forth into a great number of forms.

The case of the marsupials is said to be similar to that of the tapirs, a sub-family of placentals. Tapirs to-day occur only in Central and South America and in the Malay Peninsula, Sumatra, Java and Borneo. These "archaic" creatures once inhabited Europe and N. America, but were driven to their present abodes by more powerful placentals.

The testimony of the fossils is opposed to this explanation. The earliest-known fossil, which is undoubtedly a marsupial, *Eodelphis*, occurs in the Upper Cretaceous of N. America. This belongs to the opossum family. If the above theory be correct, the earliest fossils of placentals should not occur until long after the Upper Cretaceous. As a matter of fact, placental fossils of the Order Insectivora occur in the Upper Cretaceous both in N. America and N. Asia. These earliest placental fossils represent more than one family; in consequence, the common placental ancestor from which they evolved must have arisen long before the Upper Cretaceous. Thus, the fossils indicate that the placentals appeared on the earth before the marsupials. This is not in accord with the above theory.

If, as this theory requires, Australia was cut off from Asia after the marsupials had entered but before the placentals could reach it, numbers of fossils of marsupials, but none of placentals, ought to have been found in southern and eastern Asia before the Pliocene, when Australia is believed to have become separated from Asia.

Here again the fossils are against the theory. No marsupial fossil is known from Asia or eastern Europe, while fossils belonging to several orders of placental mammals have been found in the Miocene of Japan, China and India.

The fossils, then, indicate that, if formerly Australia was joined to Asia, the placentals and not the marsupials should have entered the former from Asia.

The absence of marsupial fossils in Asia is rendered particularly strong evidence against the theory we are criticizing, because in the case of the much smaller group of tapirs it is possible to trace by means of fossils their migration from N. America, where they lived from the Eocene onwards, to Europe where they occur from the Oligocene to the Pliocene, then to Asia where they are first seen in the Miocene.

As five fossils of the sub-family of tapirs have been found in Europe and Asia, some thirty or forty marsupial fossils ought to have been found in those countries, if it be a fact that they migrated from Asia to Australia. Not one has been found. If absence of fossils can disprove a theory, the hypothesis of the migration of marsupials from Asia to Australia is disproved.

Some evolutionists recognize this; in consequence they give another answer to our question, and put forward the hypothesis that Australia and Tasmania, on the one hand, and South America on the other, were at one time connected by an antarctic continent and that it was by this route that the marsupials invaded Australia from South America.

In favour of this hypothesis are the comparative richness of the marsupial fauna of Tasmania, the decreasing number of genera met with as one passes from the south to the north of Australia, and the resemblance of the South American marsupial families *Borhyænidæ* and *Cænolestidæ* to some Australian marsupials.

But the fossils are equally unkind to this answer. They show that Patagonia was inhabited by placentals before any marsupial reached it. Thus, if Australia was ever joined to S. America, the placentals rather than the marsupials should have reached Australia *via* the supposed antarctic continent.

The only hypothesis, compatible with both the known fossils and the theory of evolution, that would explain the present distribution of marsupials and the absence of placentals from Australia is that the marsupials evolved independently on two occasions, the opossums and their allies evolving in N. America and the *Borhyænidæ* and *Cænolestidæ* of S. America and the Australian marsupials evolving in a hypothetical antarctic continent, from which the two former groups migrated to S. America and the latter to Australia. Seeing that some evolutionists (see p. 130) believe that mammals evolved on four occasions independently from reptiles, there seems no valid reason why they should boggle at a fifth independent origin.

Such an hypothesis has the advantage over the other two that palæontology cannot at present disprove it, because the antarctic continent, if it ever existed, is now beneath the sea.

Coming now to the biological peculiarities of oceanic islands, it may be stated that these islands are believed never to have been joined to the mainland; most of them are of volcanic origin or coralline formation. Generally they are situated far from a continent and are surrounded by deep water.

As regards the absence of terrestrial mammals and the paucity of amphibia on them, Darwin wrote (*Origin of Species*, 6th ed., p. 350):

> "This general absence of frogs, toads and newts on so many true oceanic islands cannot be accounted for by their physical conditions, for frogs have been introduced into Madeira, the Azores and Mauritius, and have multiplied so as to become a nuisance. But, as these animals and their spawn are immediately

killed (with the exception, as far as known, of one Indian species) by sea-water . . . we can see why they do not exist on strictly oceanic islands. But why, on the theory of creation, they should not have been created there, it would be very difficult to explain. Mammals offer another and similar case. . . . It cannot be said that small islands will not support at least small mammals, for they occur in many parts of the world on very small islands when lying close to a continent. It cannot be said, on the ordinary view of creation, that there has not been time for the creation of mammals; many volcanic islands are sufficiently ancient. . . . Although terrestrial mammals do not occur on oceanic islands, aerial mammals do occur on almost every island. New Zealand . . . Norfolk Island, the Viti Archipelago, the Bonin Islands, the Caroline and Marianne Archipelagos and Mauritius all possess their peculiar bats. Why, it may be asked, has the creative force produced bats and no other mammals on remote islands? On my view this question can easily be answered; for no terrestrial mammal can be transported across a wide space of sea, but bats can fly across."

Apparently Darwin did not put to himself the question: As living matter seems to have originated in the sea and all land faunas to have evolved from aquatic forms, why have marine organisms given rise to terrestrial forms only on the shores of the mainland, why has this not taken place on the shores of any true oceanic island? In view of the fierce struggle for existence in the sea, is it not surprising that some marine organisms did not escape from it by seeking refuge on oceanic islands as others have done on the mainland? It cannot be said on the ordinary view of evolution that there has not been time for the evolution of amphibians from aquatic organisms; many oceanic islands are sufficiently ancient.

We have now to consider the large percentage of peculiar species and genera of animals and plants found on oceanic islands.

Considerations of space render it necessary to confine our survey to a few groups on a few islands.

The statistics that follow are mostly compiled from Wallace's *Island Life*. As this book was published in 1892, the figures it gives are out of date owing to the subsequent discovery of new forms, but, as our concern is with percentages, I have not deemed it necessary to undertake the task of bringing Wallace's figures up to date; the important point is that the percentage of peculiar forms is high, and, speaking generally, the more remote the island from the mainland, the higher its percentage of peculiar forms. This constitutes the case of the evolutionists.

Bermuda, which is some 700 miles from the nearest mainland, possesses no peculiar birds or beetles, and only 4 peculiar land shells out of a total of 21.

The Azores, 900 miles from the mainland, possess 3 peculiar species of birds out of a total of 18; 14 peculiar species (2 peculiar genera) out of a total of 74 beetles, and 32 peculiar species out of 69 land shells.

St. Helena, 1,100 miles from the mainland, possesses no peculiar birds, 128 peculiar species (39 peculiar genera) out of a total of 129 beetles and 29 peculiar species (5 peculiar genera) out of a total of 29 land shells.

In the Sandwich Islands, which are 2,300 miles from the mainland, nearly all the passerine birds are peculiar and 60 of the local species of sunbird are so different from the rest of the family that they are commonly regarded as a separate sub-family—the *Drepanidinæ*; some ornithologists, indeed, deem them a separate family.

Of some 500 species of land shells of the Sandwich Islands about three-fourths are peculiar, some differ sufficiently from all other gastropods as to be deemed a distinct sub-family—the *Achatinellinæ*—peculiar to those islands. Of the 428 beetles known from the Sandwich Islands when Wallace wrote, 352 species (99 genera) are peculiar.

No island possesses so high a percentage of peculiar animals as the Sandwich Isles. This is equally true of their plants; no less than 83 per cent. of these being peculiar to them, but all belong to one or other of the natural orders represented on the mainland.

Evolutionists believe that the animal and vegetable inhabitants of all oceanic islands are derived from mainland species, and that the majority of them in the more remote islands, owing to their new environment and isolation from the mainland, have not followed the same lines of evolution as their continental brethren and thus have become peculiar species or genera.

The belief that the flora and fauna of oceanic islands are derived from the mainland appears to be justified, because of the absence or paucity of organisms unable to cross the water or unlikely to be carried thither on driftwood, and the presence of a large number of peculiar species and genera on these islands.

The belief that all the peculiar features of these species and genera are the result of evolution undergone on the islands does not rest on so sure a foundation. It is possible that all these peculiar forms are unmodified descendants of continental forms which have become extinct on the mainland, but have survived on the islands where conditions of existence are comparatively easy.

That this is true of some, at any rate, of these peculiar forms is rendered highly probable by the fact that among the beetles peculiar to the Azores is a species belonging to a Madagascan genus. As Wallace pointed out, the probable explanation of this is that the genus in question formerly had a range extending from Madagascar to Western Europe, and, after some individuals had been blown over to the Azores from Europe, the genus became extinct in all parts of its range except the Azores and Madagascar.

Moreover, the Tuatara (*Sphenodon*) of New Zealand differs so greatly from all living reptiles as to be placed in a special order, of which there is no other living representative. But for the extinct *Homœosaurus* of the Jura of Europe, which belongs to this order, evolutionists might well have assumed that the order in question had originated in New Zealand.

If this explanation of the large percentage of peculiar forms on oceanic islands be challenged on the ground that no fossils of them have been found on the mainland, it is open to those who wish to defend it to adopt the tactics of evolutionists and allege the reason of this to be the imperfection of the geological record (see p. 142). This explanation, however, is unsatisfactory, because the number of these peculiar species and genera is so great that, if all were unmodified continental forms, the fossils of some of them ought to have been discovered on the mainland. The evidence, then, seems to indicate that new species and new genera have arisen on oceanic islands by a process of evolution.

The position is different as regards the *Drepanidinæ* and the *Achatinellinæ* of the Sandwich Islands. Apart from these there is no sub-family or family peculiar to any oceanic island. As the geological record appears to be very imperfect in respect of birds (see p. 145), if the *Drepanidinæ* formerly existed on the mainland, it is not very probable that fossils of them would have been found. The geological record is more complete in the case of Gastropods, but, as our knowledge of it is imperfect, we are not justified in asserting positively that the *Achatinellinæ* never existed on the mainland, merely because none of their fossils have been found there.

All the peculiar forms of plants that occur on oceanic islands belong to one or other of the continental natural orders.

The flora and fauna of oceanic islands, therefore, seem to indicate that new species and genera, and possibly two sub-families, have arisen by evolution.

This testimony tends to confirm that afforded by breeding operations and cannot be regarded otherwise than as unfavourable to the theory that all living organisms gradually evolved from a common ancestor. If this theory were true peculiar orders and many peculiar families should occur on oceanic islands.

IV

NASCENT AND VESTIGIAL ORGANS

Biologists adduce as strong evidence in support of the evolution doctrine the existence in organisms of structures which they usually describe as rudimentary. If these were in reality rudimentary, that is to say, in a nascent condition, in the course of being developed, their presence would indeed afford strong support to the theory. Unfortunately for the doctrine, not one of these structures is rudimentary. Some of them are vestigial, that is to say, organs in a state of degeneration. If the evolution doctrine was merely that many types have degenerated since they were created or originated, then the presence of vestigial organs would afford strong support to it. What the doctrine demands is not vestigial, but nascent organs, and the latter appear to be non-existent. Such a state of affairs seems to strike at the root of the evolution doctrine.

Better evidence of the assertion that for the last fifty years biological textbooks bring to light only that which is favourable to evolution and pass over unnoticed all that is unfavourable could scarcely be adduced than the fact that these volumes contain many references to vestigial organs, but none to nascent organs.

Darwin, however, was not guilty of this omission. He invariably endeavoured to forestall criticism. He tried hard to find some examples of nascent organs. He suggested that the wing of the penguin might be a nascent organ of flight; to-day no zoologist accepts this suggestion. Darwin was of opinion that the mammary glands of the duck-billed platypus (*Ornithorhynchus*) may be considered "in comparison with the udders of a cow, as in a nascent condition." As we shall notice (see p. 91), later research has proved this view to be incorrect.

Darwin's third attempt to cite a nascent organ reads as follows (*Origin of Species*, 6th ed., p. 399): "The ovigerous frena of certain cirripedes which have ceased to give attachment to the ova and are feebly developed are nascent branchiæ." Even if Darwin's surmise be correct, this would be the case of a change in the function of an existing organ rather than the origin of an entirely new structure.

Owen considered the simple filamentary limbs of the mud-fish, *Lepidosiren*, to be nascent terrestrial limbs; this view is not now accepted.

Beddard suggested that the small independent slip of the rectus femoris muscle seen in some birds may be a nascent rather than a vestigial ambiens muscle. This suggestion, however, does not seem to be correct.

I cannot call to mind any other structure that has been cited as a nascent organ. It may here be mentioned that the mammæ of male mammals cannot be nascent mammary glands, as they occur in so many orders; moreover, there is no evidence that they are better developed to-day in any species than they were three or four thousand years ago.

Thus, although the anatomy of thousands of species of animals has been carefully studied, it is impossible to adduce a single structure in any species which is indubitably or even probably in a nascent condition. Darwin saw that the absence of nascent organs was fatal to the theory of evolution as held by him, and, having failed in the attempt to discover any, he made the best of a bad business by disposing of it in the following summary manner (*loc. cit.*, p. 398):

> "It is often difficult to distinguish between rudimentary[1] and nascent organs; for we can judge only by analogy whether a part is capable of further development, in which case alone it deserves to be called nascent. Organs in this condition will always be somewhat rare; for the beings thus provided will commonly have been supplanted by their successors with the same organ in a more perfect state, and consequently will have become long ago extinct."

The flaw in this argument is obvious: if evolution be now taking place, the animals that are about to supplant their rivals owing to the acquisition of new and useful organs should to-day exhibit these latter in a nascent condition.

In order to reconcile the absence of nascent structures in living animals with the doctrine of evolution, it is necessary to adopt the hypothesis of Cuénot, or that of the mutationists (see p. 11).

The absence of nascent organs, then, indicates that evolution, as distinguished from degeneration or mere differentiation, is not taking place in any living animal of which the anatomy is known. This is quite in accordance with the fact that the breeders have not succeeded in producing a new family.

Although nascent organs do not seem to occur in organisms, vestigial structures are numerous. Vestigial structures are those in a state of atrophy, apparently useless and often poorly developed although well developed in other animals to which they are useful. These facts, difficult to reconcile with the theory of evolution, are fully in accord with that of creation; because, if each type be an independent creation, we should expect it to be endowed with all necessary organs at the time of its creation. Even as the individual grows old, so does the type. In each case various organs tend to degenerate with the advent of old age. Moreover, in the case of the type, changed conditions may render superfluous certain structures that were necessary during the youth of the type.

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[1] By "rudimentary" he means vestigial.

Vestigial structures tend to reveal the extent to which organisms have changed in the course of time. But it is not always easy to determine whether any given structure is vestigial. Most organs usually cited as such are nothing of the kind. No structure should be deemed to be vestigial unless it can be proved that it is of no use to its possessor in adult, embryonic or larval life *and* that it is not a structure inevitably resulting from the manner in which embryos develop.

If these tests be applied, all the alleged vestigial structures fall into one or other of the following categories:

I. *Structures that are truly vestigial*, i.e. those that were well-developed in ancestral forms, but, having ceased to be useful, have undergone gradual atrophy. Examples of such are the splint bones of the horse, the lateral toes of deer and other artiodactyls, the teeth that appear in the fœtus of toothless whales, the eyes of some animals that live in dark caverns, probably the stumps of wings exhibited by some flightless insects, and possibly the wings of struthious birds and the vermiform appendix of man. The splint bones of the horse are apparently of no use whatever to the animal; that they are relics of once functional digits seems to be proved by the fact that the fossils of members of the horse family indicate that the lateral toes have undergone gradual atrophy (see p. 107).

II. *Structures that are not vestigial.*

(*a*) *Embryonic remains*, i.e. structures, apparently of no use to the adult, resulting from the manner in which embryos develop, and which may or may not have assisted in embryonic growth. Examples of such are the organ of Rosenmüller in female mammals, the mammæ of male mammals, the right ovary and oviduct of birds, the hidden bony tail, the muscles of the external ear and the semilunar fold of the eye of man.

(*b*) *Structures homologous*[1] *with those of other organisms but which are of unusual form* because they serve peculiar functions in the animals in question. Examples of such are the pelvis (and hind limbs where these exist) of whales and sea-cows, the claws and supporting bones on each side of the vent of pythons, the pineal body in mammals, the pinna of the human ear.

Evolutionists will not allow that structures of the kinds cited under heads II (*a*) and II (*b*) are not true vestiges. This, it is submitted, is because they have mistaken the manner in which embryos develop. The grounds upon which it is contended that these are not true vestiges are set forth in Chapter VI.

The existence of true vestiges supports the evolution theory in that it shows that in course of time animals may lose some of their toes, teeth, etc., or that their eyes and possibly their wings may undergo atrophy after ceasing to be useful. This, however, is not inconsistent with the theory that every main organic type has been specially created and that some types have degenerated.

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[1] Homologous structures are those that arise from the same rudiment (*ébauche* or *anlage*) in the embryo. Thus, the wing of the bat, the paddle of the whale, the fore-foot of the tiger and the arm of man are homologous structures.

V

BLOOD REACTIONS

Some biologists believe that the serological reactions of the blood of animals afford evidence in favour of the doctrine of evolution. Although this belief is by no means universal, it is necessary to deal with the subject because, to quote Professor F. Wood Jones, "There is a wealth of semi-popular and frankly popular work, purporting to translate orthodox science to the man in the street, that makes much of these serological tests, probably because of the easy transition from the finding of a serological similarity to the claiming of a blood relationship."

The inoculation of any animal, say a rabbit, with small doses, given at intervals, of the serum of some other animal, say a horse, results in the appearance in the blood of the animal so inoculated of what is known as an anti-serum, which has the property of causing a precipitate when added to the serum of the blood of a member of the family (the horse in our example) of which the serum was injected into the other animal, but not when added to the serum of the members of other families.

Evolutionists hoped, by making use of this knowledge, to be able to discover the kinship of all animals. To this end a vast number of serological experiments have been made. The results of no fewer than 16,000 experiments made by Dr. H. F. Nuttall and his colleagues have been tabulated and set forth at great length in a volume, published in 1904, entitled *Blood Immunity and Blood Relationship.*

Nuttall is of opinion that the experiments in question prove that "a common property has persisted in the bloods of certain animals throughout the ages which have elapsed during their evolution from a common ancestor, and this in spite of differences of food and habits of life."

This opinion has been formed, because Nuttall takes into account only the experiments that appear to support the doctrine of evolution and rejects those that do not, because he believes that in these "some error" has crept in.

He has, however, candidly included in his tables the experiments into which he believes error has crept, in consequence they contain all the data afforded by his work.

Nuttall's table (see opposite page) embodying the results of his tests with anti-human serum is here reproduced in preference to any other, as it throws light on the supposed kinship of man with the lower animals.

Column 1 states the class or other group of animals to the serum of which anti-human serum was added.

Column 2 gives the number of experiments in each group in which there was no visible change after the addition of the anti-human serum.

Column 3 gives the number of experiments in each group in which very faint clouding of the serum resulted.

Column 4 gives the number of experiments in each group in which medium clouding resulted.

Column 5 gives the number of experiments in each group in which marked clouding resulted.

Column 6 gives the number of experiments in each

ANTI-HUMAN SERUM REACTIONS

1.	2. No Reaction.	3. Faint Reaction.	4. Medium Clouding.	5. Marked Clouding.	6. Full Reaction.
97 Primates:					
34 Human (4 races)	—	—	3 (8%)	7 (21%)	24 (71%)
8 Anthropoid Apes (3 species) . .	—	—	—	—	8
36 Old World Monkeys (26 species) . . .	3	—	26 (72%)	3 (8%)	4 (10%)
13 New World Monkeys (9 species) . .	3	2 (15%)	5 (38%)	3 (23%)	—
4 Marmosets (3 species) . . .	2	1	1	—	—
2 Lemurs . .	2	—	—	—	—
29 Bats	26	3 (10%)	—	—	—
15 Insectivora . .	13	2 (13%)	—	—	—
97 Carnivores . .	70	13 (13%)	14 (14%)	—	—
65 Rodents . . .	53	7 (11%)	5 (7%)	—	—
70 Ungulates . .	40	19 (27%)	11 (16%)	—	—
3 Cetacea . . .	—	3 (100%)	—	—	—
13 Edentates . . .	12	1 (7%)	—	—	—
26 Marsupials . .	25	1 (4%)	—	—	—
1 Monotreme . .	1	—	—	—	—
320 Birds . . .	319	1 (·3%)	—	—	—
49 Reptiles . . .	49	—	—	—	—
14 Amphibians . .	14	—	—	—	—
19 Fish	19	—	—	—	—
7 Crustaceans . .	7	—	—	—	—

group in which a precipitate resulted, i.e. in which the full reaction occurred.

Thus in the case of the serum of 34 human beings to which anti-human serum was added there was a precipitate (full reaction) in 24 individuals, marked clouding in 7, and medium clouding in 3.

When commenting upon the results embodied in the above table, Nuttall lays great stress on the fact that the maximum reaction occurs only amongst the Humans, Anthropoids and Old World Monkeys. He considers this to prove near blood relationship of these three groups. If so, it proves that some of the human beings experimented on were less closely related than the anthro poid apes to their fellow-men, since all anthropoids but only 71 per cent. of humans show full reaction to anti-human serum. Moreover, three of the humans exhibit closer relationship to some Old World and New World monkeys than they do to some of their fellow-men; indeed, some of them are as nearly related to carnivores, rodents and ungulates as to their own kind. This, as Euclid would say, is absurd.

These anti-serum reactions regarded as tests of kinship teem with similar absurdities. They show that some whales are more nearly related to man than some monkeys are. The anti-serum of the ungulates (hoofed animals) shows that their nearest relatives are the Cetacea, but the anti-serum of the Cetacea shows that bats are their nearest relatives.

Other examples of relationships "proved" by these anti-serum tests are that the crane is nearly related to the greenfinch but far removed from the hedge sparrow; indeed the crane is more closely related to the emu, silver pheasant and the turtle than to the hedge sparrow!

The most that can be said of the evidence of these anti-serum tests is that among mammals (not birds) full reaction is never caused in any blood outside the order and is often confined to members of the family. This may indicate that among the characteristics of most families is some chemical peculiarity of the blood.

That these anti-serum tests would lead to curious results might have been anticipated from other known facts regarding the qualities of blood. For example, the blood of human beings exhibits remarkable variations. It often happens that the blood of one man cannot be transfused into another man of the same race or nationality without evil effects. In some instances the serum of a Macacus monkey when transfused into humans did no harm, in others it was injurious. Human beings appear to fall into four distinct classes according to the reactions of their bloods *inter se*. The blood of other animals exhibits similar peculiarities.

Eel serum breaks up the red corpuscles of adult rabbits but not of newborn rabbits. From this it would appear that the chemical nature of the blood may change during the life of an individual.

VI

THE DEVELOPMENT OF THE ANIMAL EMBRYO

EVERY living organism begins its existence in the form of a single cell; some animals retain this form throughout their life.

The early stages of growth of the embryo of every higher animal consist in the formation of new cells by the splitting up of the first cell into two; these then become four by division, and so on. This process, which is known as segmentation, results, in the case of eggs that contain little or no yolk, in the formation of a hollow ball the surface of which is composed of a single layer of cells. By this arrangement every cell is able to derive nourishment directly from the outside. The embryo, when it attains this spherical form, is known as the blastula. Some adult organisms retain this form throughout life, as for example, Volvox.

The next step in the development of the embryo ot a higher animal is the formation of what are known as the germinal layers, from which all the tissues of the adult arise. There are three such layers, an outer, middle and inner—the ectoderm, mesoderm and endoderm. As it is an advantage for each cell to obtain the nourishment it requires without this having first to pass through other cells, in eggs that contain no food in the form of yolk the inner layer is formed by the inpushing of one end of the blastula, just as an india-rubber ball with a hole in it can be pushed in to make a cup. Thus the embryo becomes a cup having a wall of two layers of cells. In this stage it is known as the gastrula. Some adult animals, such as sponges, retain this configuration throughout life. Later a stage is reached in the case of all vertebrates in which the embryo is elongated and exhibits on each side, just behind the head region, a series of vertical ridges, known as arches, through which run minute blood-vessels; between these arches are furrows. In the case of fish the furrows eventually become clefts, and the arches grow gills. In the higher animals, contrary to what is usually stated, these furrows do not normally become clefts.

Facts such as these led Haeckel to enunciate the "biogenetic law" or recapitulation theory: "The developmental history or ontogeny of every multicellular organism recapitulates the various stages of its ancestry and thereby every organism resembles roughly at each stage of its development the form of one of its ancestors."

This theory was warmly welcomed, for it seemed to afford proof of the truth of that of evolution. The recapitulation theory, although erroneous, had one good effect; it was a great stimulus to the study of embryology. The embryonic development of many animals was studied in order to find further proofs of evolution. It was thought that the knowledge of the ontogeny of any animal would enable us to unravel its evolutionary history.

The good effects, however, of the recapitulation theory were largely neutralized by the fact that its acceptance led zoologists to take a wrong view of embryonic development and to pay attention only to discoveries that appear to support the theory and to neglect those that seem to be unfavourable to it.

It is but fair to state that a few zoologists have never accepted the theory, notably the Englishman, Adam Sedgwick, and the Swiss, His.

For some years the theory was in high favour and some new facts were brought to light that appeared to support it, but along with these were many that did not seem to fit in with it. In consequence it became necessary to modify the theory. It had to be admitted that the development of the embryo follows only the main lines of its descent, that the exigencies of embryonic life necessitate the development of special organs that are not ancestral, also that the embryo does not repeat every stage of its long pedigree, but makes some short cuts.

As new facts accumulated, admissions greater than the above had to be made. We find Milnes Marshall writing as early as 1894: "The development of the embryo is indeed a history, but a history of which entire chapters are lost, while in those that remain many pages are misplaced and others so blurred as to be illegible."

Admissions such as these strike at the root of the theory. That the embryo of an individual may be compelled by a law of nature to pass through all its ancestral stages is not surprising, but that it should have to pass through some stages and not others is surprising. Why the exemption? That some earlier ancestral stages should be repeated after later ones is unintelligible.

Most zoologists now recognize this. In the words of Nordenskiöld, "Time has dealt hardly with Haeckel's ontogenetical theories." As, however, a few zoologists, for example, Professors E. A. MacBride and E. G. Conklin, still believe in it, many accept it with qualifications, when its teachings support any thesis it is usually invoked, and it is paraded as proof of evolution in every popular textbook, it is necessary here to set forth briefly a few of the facts that are fatal to the theory in any form:

1. Admittedly it does not apply to the embryonic development of plants. This is inexplicable if recapitulation be a law of nature, and if, as evolutionists believe, plants and animals have descended from a common ancestor.

2. It sometimes happens that the embryos of closely-allied species pursue different developmental courses. Thus the Crustacean *Peneus* and the common crayfish resemble one another so closely that, if there be anything in the evolution theory, they are near akin, nevertheless *Peneus* hatches out in the form of the larva known as the Nauplius and passes through the stages known as Metanauplius, Protozoea and Zoea before it assumes the adult form, whereas the crayfish emerges from the egg in a form like that of the adult, after having undergone a development as direct as possible. Unless the relationship of these two forms be spurious, both cannot recapitulate their supposed ancestral history.

The crabs furnish an even more striking example of closely allied species of which the embryonic development is very dissimilar. Most crabs leave the egg as a Zoea larva, then pass through two more stages before they assume the adult form. Some, however, leave the egg in the adult form. Many of the latter are fresh-water species which would be carried out to sea by the current of the river in which they are hatched, if they emerged from the egg as free-swimming larva as most sea-crabs do. Obviously both the crabs that undergo metamorphosis and those that do not cannot recapitulate the supposed history of their race.

3. Another fact fatal to the recapitulation theory is the early stage at which every embryo assumes all the features of the genus to which it belongs. In their zeal to prove the truth of the evolution theory many zoologists

have failed to pay proper attention to this fact; indeed, some have actually misled the public on this subject. T. H. Huxley gives, in *Man's Place in Nature*, figures of the embryos of a dog and a human being to show how closely they resemble one another, but he refrains from stating that the latter is an embryo of the twenty-third day. He describes in some detail the development of each embryo up to this stage, emphasizing the similarity of the process in the two cases. He does not continue his account beyond this stage, alleging that to do so would be tedious and unnecessary for his purpose. He ought to have added that to do so would have destroyed his argument! He is guilty of more than mere omission. He writes: "Indeed it is a very long time before the body of a young human being can be readily discriminated from that of a young puppy." The truth is that by the time the human embryo is forty days old it is impossible to mistake it for that of a dog, and by the forty-fifth day it is unmistakably that of a human being.

Sir Arthur Keith writes of the human embryo: "Human characteristics begin to peer through its higher primate qualities before development is a month old." Thus while the layman cannot recognize an embryo as human until the forty-fifth day of development, an expert can do so by the thirtieth day.

It is to be regretted that in their anxiety to demonstrate that man has descended from a lower animal some evolutionists have gone to the length of publishing sketches that exaggerate the similarity between human and other embryos. A case of this is recalled in a recent issue of the *Spectator*. In 1909 Dr. A. Brass charged Haeckel with "faking" diagrams in *Der Menschen Problem* (1907). In answer to this charge Haeckel wrote (*Müncher Allgemeine Zeitung*, January 1909):

"I begin at once with the contrite confession that a small number of my diagrams are really forgeries in Dr. Brass's sense. Hundreds of the best zoologists lie under the same charge. The great majority of all the morphological, anatomical, histological and embryological diagrams . . . are not true to nature, but more or less doctored, schematized and reconstructed."

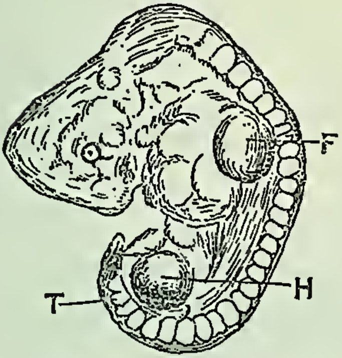

FIG. 1.—Human Embryo, ⅓-inch long, when tail is developed.
T, Tail; F, Fore-limb; H, Hind-limb.

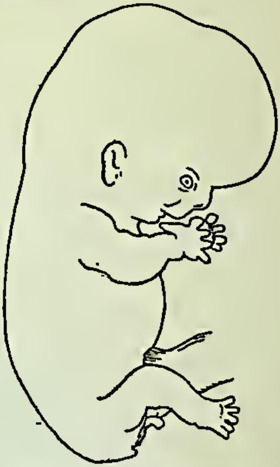

FIG. 2.—Human Embryo at end of Second Month. × 2½. (After His.)

On a par with the above is the usage of the term "gill cleft" to describe the visceral furrows of mammalian embryos (see p. 49).

The human embryonic period is normally about nine months. Haeckel gives in *The Last Link* thirty-two stages through which man is supposed by him to have passed during his evolution from a single-celled ancestor. If this supposed history were recapitulated at an even rate, the passage through each of the above stages would occupy about eight days, and it would be impossible by inspection to ascertain whether or not any embryo were human until about the 270th day of its existence, whereas it is possible to do so about the 30th day. Man is not peculiar in this respect. All other embryos exhibit the same phenomenon. The fœtus of a cat is distinguishable from that of a dog before the teeth or claws show themselves; in other words, an embryo bears the stamp of the family to which it belongs before the appearance of the features by means of which systematists distinguish its family from other families.

Clearly, then, the development of an embryo does not follow a supposed ancestral history; the final form of every organism is determined at a very early stage of its development. *If in the past any type has been transformed into another type, the transformation must have been determined very early in embryonic life.*

In cases of changes proved to have been effected in organisms, as, for example, the loss of one or more digits, the process is not recapitulated by the embryo.

The foot of the horse exhibits only one toe—the third or middle one. The splint bones are relics of the second and fourth metapodials (wrist and ankle bones). There are no traces of the second and third toes. This loss of the lateral toes is not recapitulated in embryonic development. As Retterer has shown, from the beginning the embryonic rudiment of the horse's limb foreshadows the fact that it will not have five toes, because, instead of its breadth being greater than its length and depth (thickness) as in the embryos of five-toed animals, its breadth is about equal to its thickness.

In the budding limb appear rays of precartilage which will develop into the metapodials (wrist or ankle bones) of the adult. In the embryo of the horse only three of these rays appear, the middle one being always larger than the others. Then, at the distal end of the median ray. another ray forms which will develop into a digit.

No such rays develop in connection with the outer metapodial rays. Despite this Professor Osborn asserts that the second and fourth fingers of the horse appear in the embryo and "persist for several months in the early stages of uterine life." This, as Vialleton remarks, illustrates well the manner in which popular books deal with facts affecting the recapitulation theory. *So far as is known, no embryo ever exhibits more digits than are seen in the adult.* The embryonic foot sometimes displays more digital rays than there are digits in the adult foot, but the additional rays, unlike the others, never reach the end of the limb to form festoons. "The extremities of the limb," writes Retterer, "no longer pass, in actual species, through ancestral stages; the original form has been lost among the tetradactyls, tridactyls, didactyls and monodactyls, which display only the type modified by adaptation."

This is precisely what those not enamoured of the recapitulation theory would expect. The gradual loss of a digit must surely be effected as follows: The digit in question fails to attain its normal size in some individuals, presumably as the result of its growth ceasing at an earlier stage than that of the other digits. In successive generations this cessation of growth will take place at earlier and earlier stages, until a time comes when the digit in question fails to protrude, and eventually fails to appear even in the embryo.

In this connection it is of interest to notice that Popowa discovered in the budding limbs of the embryos of the cow and the pig traces of a fifth ray. Here, although the fifth toe has disappeared in the adult, it has not completely vanished in the embryo.

Evolutionists naturally put an evolutionary interpretation on the phenomena of embryonic development.

All these, however, are capable of another interpretation. We will now set forth a non-evolutionary interpretation of the more striking features of embryonic development.

1. Every metazoan (multicellular animal) begins life in the form of a single cell. Evolutionists assert that the reason of this is that all have descended from a unicellular ancestor, i.e. they interpret the phenomenon in accordance with the recapitulation theory.

A little reflection will show that every metazoan, no matter how it originated, must of necessity begin its existence in some very simple form such as a single cell.

Every individual has to exhibit the characteristics of its species and some of the idiosyncrasies of each parent, without making great demands on the tissue or strength of either parent. Obviously each parent must part with a portion of its body containing what may perhaps be described as the germ of every organ and structure, must, so to speak, give out the quintessence of itself. These two quintessences must be different on each occasion on which offspring are produced, in order to account for the phenomenon of variation. The quintessences of each parent must coalesce; and steps have to be taken to prevent a double organism being formed.

The cells of which the body of every metazoan is composed correspond to the bricks of a building. Even as every building is begun by the laying of one brick or stone, so does the existence of every metazoan begin with the laying down of a single cell that contains within it the potentiality of developing into an organism.

2. The great similarity in appearance of all embryos in the earliest stages.

"It is certainly no mere accident," writes Professor Conklin [*Creation by Evolution* (1928), p. 72], "that all eggs undergo a series of divisions or cleavages which lead to the formation of a

> hollow sphere, the blastula . . . that the cleavage of eggs in types so different as flat-worms, annelids and molluscs is almost cell for cell the same. . . . These fundamental resemblances call for some explanation and the only explanation that has ever been proposed is evolution."

The above is another example of the manner in which books written to popularize evolution sometimes deal with facts.

There is another explanation, and this was given in 1917 by D'Arcy Thompson in his *On Growth and Form.* I take the liberty of quoting from this book at some length. Of embryological development up to the eight-cell stage D'Arcy Thompson writes:

> "All possible groupings of or arrangements whatsoever of eight cells (where all take part in the *surface* of the group, none being submerged or wholly enveloped by the rest) are referable to some one or other of *thirteen* types or forms, and . . . all the thousands and thousands of drawings which diligent observers have made of such eight-celled structures, animal or vegetable, anatomical, histological or embryological, are, one and all, representations of some one or other of these thirteen types; or rather indeed of somewhat less than the whole thirteen, for there is reason to believe that, out of the total number of possible groupings, a certain number are essentially unstable and have at best, in the concrete, a transitory and evanescent existence."

Again he writes:

> "Now that we have seen how a certain limited number of types of eight-celled segmentation . . . appear and reappear, here and there, throughout the whole world of organisms, there still remains the very important question, whether, *in each particular organism*, the conditions are such as to lead to one particular arrangement being predominant, characteristic, or even invariable. In short, is a particular arrangement of cell partitions to be looked upon (as the published figures of the embryologists are apt to show) as a *specific character*, or at least a constant or normal character, of the particular organism? The answer to this question is a direct

> negative. . . . Rauber has put on record a considerable number of variations in the arrangement of the first eight cells which form a discoid surface about the dorsal (or animal) pole of the frog's egg."

From these Thompson selects no fewer than six essentially different types.

From the foregoing it is apparent that the similarity of embryos in the early stages has no connection with any supposed blood relationships, but is the result of the physical, physiological and mechanical conditions under which embryos develop.

3. The so-called fish stage through which the embryo of every one of the higher animals, including man, passes.

J. McCabe writes of the human embryo (*Evolution*, p. 88):

> "In the third week of development, when the embryo (less than a quarter of an inch long) has something of the appearance of a tadpole (minus the gills)—a large head and long tail, with no traces of limbs—a series of five slits or folds appears in the throat or chest region. That these (though not open) are real gills is seen at once on dissecting the embryo. The rudimentary heart is found to be in the position and of the same structure as that of the fish, and its chief arteries rise in six double arches over the gill arches. The whole of this distinctively 'fish' arrangement —which is found also in the embryos of all other mammals, reptiles and birds—has no function and no utility. It will entirely disappear within a week or two. It is a most striking illustration of the mysterious law of the reproduction of ancestral stages, and a most curious reminiscence of the Silurian fish ancestor of all the vertebrates."

The non-evolutionary explanation of the so-called "fish" stage through which the embryo of every higher animal passes is that *it is a mechanical necessity.* It is physically impossible for a single cell to develop into a mammal without passing through such a stage. The fact that in the course of its construction a four-storeyed building passes through a one-storeyed stage is not evidence that it evolved from a single-storeyed building. Similarly, the fact that the embryo of every mammal passes through a stage in which it bears a superficial resemblance to a fish is not evidence that mammals have descended from fish.

In order to appreciate the significance of the various stages through which the developing embryo passes it is essential to take into consideration the physiological conditions to which the embryo must conform. Failure to do this has led some embryologists astray.

The cells of which every metazoan is composed may be compared to the bricks forming a building, but these living bricks are peculiar in that all are derived from a single initial brick. This and all derived from it have the property of growing and dividing to form more living bricks. In order that they may grow they must obtain food, that is material which they can assimilate. Hence an essential condition of the development of an embryo is that every active cell of which it is composed shall receive a continuous supply of nourishment. In all embryos and organisms of which the structure is at all complex the required nourishment is obtained in the form of blood. It is therefore essential that the embryo of every higher animal be provided at a very early stage of its development with a system of blood circulation. This necessitates the early formation of a heart, or pumping organ, and a simple system of blood-vessels. As the heart of a higher animal is of necessity a complicated organ, the construction of which occupies considerable time, during most of which the embryo must have a pumping organ, one or other of two devices must be followed. Either a simple heart must first be developed to maintain the embryo while the more complicated heart is being manufactured, and the simple heart be scrapped after it has served its purpose, or a simple heart must be developed of such a nature that it can be gradually converted into the adult heart while it is working. In the case of the heart the latter course is adopted; in that of some other organs, such as the kidney, the former is followed (see p. 51).

In every vertebrate embryo a heart arises at a very early stage. Two tubes are formed, which run parallel; these coalesce to form a single tube, the wall of the front part of which thickens; this thickened part becomes separated from the thinner hind part by valves. The heart is now an effective pumping machine composed of two communicating chambers; a posterior one, the auricle, that receives blood from the body, and an anterior one, the ventricle, which, by the contraction of its thick muscular wall, expels blood into the arteries, the backward flow being prevented by the valves between the two chambers. In fish this type of heart persists throughout life, being suitable for a gill-breathing animal of comparatively simple structure. Animals higher in the scale need a more complicated heart and in them the embryonic heart becomes three- or four-chambered, as the case may be, by the growth of a septum in one or both of the chambers.

Fish have one type of heart, amphibia another, reptiles a third, birds a fourth and mammals a fifth. Each group has the type of heart best suited to its needs.

Clearly, then, the reason why the mammalian embryonic heart is at first a simple tube is, not that mammals evolved from fish, but that, as the mammalian embryo must have a working heart at a very early stage, the simplest possible type of heart develops. As development proceeds the form of the heart changes in accordance with the increasing demands made on it by the growing embryo.

The visceral arches are as necessary to the embryo of the higher vertebrate as they are to the fish embryo. In the case of the higher vertebrates their function is to form part of the lateral wall of the cephalic extremity of the embryo, to serve as paths for the aortic arches, and, finally, to contribute to the formation of various organs.

As regards the blood-vessels that pass along them; at the moment the heart is ready to function the head region of the embryo is in urgent need of a supply of blood; in consequence, each branch of the ventral aorta pushes forward and passes along the foremost visceral arch and so reaches the back without piercing the alimentary canal. Having attained the top of the visceral arch each vessel bends back and conveys blood to the middle and hind regions of the embryo. Then aortic arches arise in the next three visceral arches. When these are formed there exist four vessels on each side conveying blood from the ventral to the dorsal aorta. By this time the head region of the embryo has attained such dimensions as to need a better blood supply; in consequence, the first three aortic arches become absorbed or rather are converted into the internal carotid and other arteries that supply the head. Meanwhile, another aortic arch arises in the last visceral arch. This eventually forms part of the pulmonary artery. The fourth aortic arch persists as part of the aorta of the adult. Sometimes an aortic arch develops in the fifth visceral arch, but this seems to disappear without giving rise to any blood-vessel in the adult.

Having served their purpose in early embryonic life the visceral arches give rise to various structures:

1. The first or mandibular arch develops into the upper and lower jaws in elasmobranch fish; in other fish and in amphibia, reptiles and birds, it forms the lower jaw and Meckel's cartilage, and in mammals the incus and stapes (bones in the ear) and Meckel's cartilage.

2. The second or hyoid arch forms the hyoid arch in fish, the columella and part of the hyoid apparatus in amphibia, the stapes in reptiles and birds, the stapes, styloid process, external ear cartilage and hyoid apparatus in mammals.

3. The third arch—the first visceral arch—gives rise to the first gill arch in fish, part of the hyoid apparatus in amphibia, reptiles and birds, while it disappears in mammals.

4. The fourth arch—the second visceral arch—forms the second gill arch in fish, apparently part of the hyoid apparatus in amphibia, reptiles and birds, and part of the thyroid cartilage (Adam's Apple) in mammals.

5. The fifth arch—third visceral arch—gives rise to the third gill arch in fish, *disappears in amphibians, reptiles and birds*, and forms part of the thyroid cartilage in mammals.

6. The sixth arch—fourth visceral arch—gives rise to the fourth gill arch in fish, *disappears in amphibians, reptiles and birds*, and gives rise to the epiglottis in mammals.

From the foregoing it is clear that McCabe's assertion that the arrangement of the arteries and arches "has no function and no utility," is incorrect.

Up to the time of the appearance of these visceral arches the embryonic development of all vertebrates follows the same lines, because all are constructed on the same general plan. From this stage onwards development differs according as the animal breathes in water or air.

In a fish or other gill-breather the membranes forming the bottoms of the furrows between the arches become absorbed; thus are formed the gill clefts. These are narrow at first but gradually broaden. Meanwhile gills grow on the arches, and the blood-vessel in each arch divides longitudinally into two vessels, one of which is connected with the main ventral blood-vessel and the other with the main dorsal vessel. The two parallel vessels thus formed in each arch communicate by means of a network of tiny blood-vessels, which extend into the gills. By this arrangement the blood that comes from the heart in a venous or impure condition flows into the gills where it is aerated, then it passes into the dorsal blood-vessel, thence to all parts of the body.

In the embryo of a reptile, bird or mammal, no clefts form between the arches, nor do the blood-vessels in the arches become split into two. Thus, *in these creatures neither the arches nor the blood-vessels they contain assume any of the characteristics of gills.* It is, therefore, clearly incorrect and misleading to call them gill arches. The embryo of a higher animal never passes through a fish stage. The embryos of fish and those of higher animals develop along the same lines until the visceral arches appear, after which they develop along different lines, leading respectively to the formation of a gill-bearing and a lung-bearing animal. Embryology lends no countenance to the view that the higher vertebrates evolved from a fish-like ancestor.

It is only by putting far-fetched and artificial interpretations on embryological phenomena that they can be made to fit in with the evolution hypothesis.

We have noticed the fate of the various embryonic arches. Most evolutionists interpret this as follows:

> "The gill arches are not entirely lost however," writes Professor H. E. Walker [*Biology of the Vertebrates* (1928), p. 516], "for certain parts of the mature skeleton (of animals above fish) are directly derived from the primitive splanchno-cranium inherited from ancestral water-dwellers. Nowhere is the thrift and resourcefulness of Nature better exemplified than in the disposal of the parts of the splanchno-cranium after they have outlasted their original use, owing to the emergence of vertebrates from life in water to land. . . . The embryological skeletal material, which originally had to do with respiration and the support and protection of the anterior end of the digestive tube, has now, by a series of makeshifts, assumed very diverse functions, such as the support of the vocal apparatus and the muscular tongue, or the transmission of sound waves to the inner ear."

According to this theory mammals, in the words of Walker, "hear through the jaw-bones of their phylogenetic ancestors."

In this connection it is necessary to bear in mind that in no known fish do *all* the so-called gill arches give rise to gills. As we have noticed, in Elasmobranchs the mandibular arch forms the jaws of the adult. If the evolution theory be true, this can only mean that, for some reason or other, some unknown vertebrate lost its original mouth and used its first gill arch as one!

The fate of the third and fourth visceral arches demonstrates that the evolutionary interpretation of embryological phenomena is incorrect, and indeed is of itself almost sufficient to disprove the recapitulation theory. According to this theory, these two arches exist only because the amphibia evolved from fish, they are of no use to the amphibia. This being so, they should have undergone atrophy, as the hind limbs of whales are supposed to have done, and by the Trias all traces of them should have been lost. The recapitulationist has to suppose that they not only did not undergo atrophy, but after many millions of years suddenly acquired the power of developing into the epiglottis and contributing to the formation of the thyroid cartilage in mammals. Had not the history of these two arches been different from that of every other useless organ mammals could not have evolved!

On the recapitulation theory the heart and visceral arches are by no means the only parts of the embryo said to pass through a fish stage. We will consider the case of two other organs which are cited as affording strong evidence of the descent of the higher vertebrates from a fish-like ancestor.

The kidney is the organ by means of which the waste products of the tissues are removed from the body. In the higher animals this is a complex structure the development of which is necessarily a long process. As the embryo needs a kidney at an early stage, one has to be developed to do the work while the adult kidney is being fashioned. What is known as the pronephros or head kidney is first formed. This consists of a row of two or three nephridia on each side of the body. These nephridia are tubes, one end of which opens into the body cavity and the other into a common duct leading to the exterior. Each nephridium comes into contact with a bunch of tiny blood-vessels known as a glomerulus. The waste products of the embryo at this stage are taken up by these nephridia, from the body cavity and the glomeruli, and pass into the common or segmental duct and so out of the embryo. As the embryo increases in size new nephridia arise behind the first ones. These are of more complicated structure and so are described as a second kidney, known as the mesonephros or middle kidney. As the mesonephridia increase in number the pronephros gradually undergoes atrophy. A kidney of the mesonephros type suffices to carry off the waste products of comparatively simple organisms, in consequence in fish it persists throughout life as the functional kidney; in some fish the pronephros persists along with the mesonephros. The mesonephros is not adequate for the needs of organisms higher than fish, in consequence a far more complicated kidney, known as the metanephros or hind kidney, develops behind the mesonephros. When this new kidney is ready to function, the nephridia of the mesonephros become absorbed, but their duct persists, being used to convey the male genital products.

The development of the human kidney, illustrated by diagrams, is fully described in embryological textbooks and in Vol. 22 of the latest edition of the *Encyclopædia Britannica.*

The reason why the early embryonic kidney, instead of being converted into, is replaced by, the adult kidney thus appears to be, not that the embryo is compelled to recapitulate prepiscine and piscine stages, but that embryonic conditions require the kidney at first to be situated far forward—a position that would be inconvenient in the adult.

The backbone makes its appearance in the form of a long column of cells immediately below the nerve tube; at this stage it is known as the *chorda dorsalis* or notochord.

Then a membranous sheath arises enclosing both the chorda and the neural tube. In this sheath are a number of condensed areas, which gradually become converted into cartilage, the chondrification of each area beginning in two places, one to the right and the other to the left of the chorda. Thus arise the vertebræ, which eventually become ossified. The ossification of each vertebra begins at first from three centres, later also from five accessory ones.

In a few animals the backbone retains throughout life the form of the notochord and in some fish the vertebræ remain cartilaginous.

Recapitulationists assert that the above is a very roundabout way of forming the backbone, which is adopted merely because the embryo of a higher vertebrate is compelled to recapitulate ancestral stages.

The truth is that the method of development adopted is a necessary consequence of the properties of living tissues.

While the backbone is forming the embryo is growing rapidly and every part of it needs a continuous supply of nourishment. The nature of bone is such that the presence of numerous small blood-vessels is essential for its development. These are not necessary for the growth of membrane and cartilage, which, in consequence, can be formed at a time when the production of bone is impossible. Moreover, cartilage can grow interstitially, bone cannot. As soon as the embryo is sufficiently advanced to enable blood-vessels to form, ossification begins. As ossification is a slow process, in order to expedite it the ossification of every vertebra and every bone in the body is effected from several centres.

Clearly then, evolution or no evolution, the formation first of membrane, then of cartilage, and, finally, ossification from several centres is the most expeditious method of forming bone.

To speak, then, of a mammalian or reptilian embryo passing through a fish stage is incorrect. It never really resembles a fish. Even at the time when it displays a notochord, tubular heart, visceral and aortic arches and a simple kidney it does not resemble a fish; at this period its eyes are merely vesicles devoid of a lens.

4. The presence of a well-developed tail in the embryo of man and other tailless vertebrates.

The human embryo displays, from the fifth to the eighth week of its existence, a well-developed tail, together with the muscles connected therewith; the latter eventually become absorbed into the surrounding tissue and the tail vertebræ become condensed into the coccyx.

Evolutionists regard this as proof of man's descent from a tailed ancestor; they regard the human coccyx as the vestige of a tail. Cases are on record of babies being born with a regular tail. This is supposed to be a case of reversion or atavism. It is submitted that the correct explanation of the presence of the tail in the embryo of a tailless vertebrate is that the body of every vertebrate is built up round the notochord or backbone. Every vertebrate is constructed on the same plan and the embryo exhibits the rudiments from which the various organs, such as the limbs and tail, eventually develop. The fate of each rudiment varies with the order to which its possessor belongs, that of the fore-limb may develop into the foreleg of the tiger, the paddle of the whale, the wing of the bat, or the arm of man. The rudiment from which the tail arises may develop into a prehensile tail (New World monkeys), a non-prehensile tail that may be long or short, a swimming organ (Cetacea and Sirenia), or, as in man, it may shrivel up.

When speaking of the lateral toes of the horse (see p. 41) we noticed that these do not appear in the embryo and then shrivel up. If the comparatively recent loss of these is not recapitulated in the embryo, is it likely that the far older loss of the tail in primates should be recapitulated?

For the reasons stated in connection with the loss of toes in the horse had man been descended from a tailed ancestor, only the least trace of tail should appear in the embryo. The fact that a considerable tail is exhibited indicates that this is a structure necessary for the building up of the vertebrate body.

We are now in a position to understand the meaning of certain structures that are ordinarily described as vestigial but, in fact, are not such.

In Chapter IV we noticed that some of these are embryonic remains, the results of the manner in which embryos develop. The hidden bony tail of man and other tailless vertebrates is one of these.

A curious feature of all the higher vertebrates is that each sex exhibits what appear to be very degenerate parts of the generative apparatus of the opposite sex. Examples of such parts are the organ of Rosenmüller in females and the mammæ of males. It has been said that these are relics of a hermaphrodite ancestor, one in which the organs of both sexes were functional. This is highly improbable, because, although all kinds of so-called primitive vertebrates exist to-day, hermaphrodism is virtually unknown in this great group. It does not occur in a single living reptile, bird or mammal; it seems never to occur normally in amphibia; occasional cases, however, have been reported in newts, frogs and toads. A few fish appear to be hermaphrodite.

The correct manner of interpreting the presence in one sex of these traces of the organs of the other sex in the case of mammals appears to be to regard them as embryonic remains.

The embryo of every higher animal exhibits all the parts necessary for the production of both male and female organs; the superficial cells from which are formed the ovaries and the deep-seated cells from which arise the seminiferous tubes and the Wolffian and Müllerian ducts that carry away the male and female products. For a time the embryo develops as though it were going to produce an hermaphrodite, then one set of organs ceases to develop and undergoes more or less complete atrophy.[1]

The most reasonable explanation yet offered of this phenomenon seems to be that of Vialleton [*Morphologie Générale* (1925), p. 554]:

> "The presence of both sexual *ébauches* is probably in harmony with the mechanism of development. It is possible that the *ébauches* of the two genital ducts assist one another. Particularly in mammals the reunion of the Wolffian and Müllerian ducts in the genital cord, involving the formation of a dense mesenchymatous sheath around them, facilitates the growth of the complex coats of the female genital ducts developed in connection with gestation and parturition."

Even if these do not mutually assist one another, the presence of both is in accord with the fact that every vertebrate embryo at an early stage displays the rudiments, or buds, or first beginnings (*ébauches* or *anlage*) of all the major organs, even of those that do not develop. Thus, the embryos of limbless animals exhibit for a time the rudiments from which arise the limbs of other animals, and male embryos exhibit the rudiments of female organs and female embryos those of male organs.

The foregoing facts indicate that the animal embryo in the course of its development does not follow a number of supposed ancestral stages but acquires directly and expeditiously all the features of its family. Beginning as a single cell, it becomes by segmentation a mass of cells; then the germinal layers are formed. Up to this point all embryos are more or less alike. Thereafter the similarity ceases, because every animal belongs to one or other of the great groups or phyla, each of which is constructed on a peculiar plan. After the germinal layers are formed, the first rudiments of every organ of the phylum to which the animal belongs arise. At this stage the appearance of the embryo varies with the phylum to which it belongs, but the embryos of all members of the same phylum bear a general resemblance to one another. After this each rudiment follows a line of development in the course of which it acquires, first, the features of its class, then those of the order, later those of the family and, finally, those of its genus and species. The rudiments of the organs appear at a very early stage, and each rapidly assumes the characters of the order to which it belongs. All this is opposed to the recapitulation theory, according to which it should be impossible to distinguish the embryo of one order of a class from that of any other until a late stage of development; for example, the embryo of a whale, in common with that of a quadruped, should exhibit well-developed hind limbs until a few weeks before birth.

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[1] Goldschmidt has demonstrated in the case of the gypsy-moth whether any embryo will develop into a male or female depends on the relative speeds with which the male-producing and the female-producing genes produce their effects.

The view of embryological development herein set forth affords a simple explanation of the anomalies that occasionally occur in nature, such as a tail or right aorta in human beings. The stimulus that normally causes the absorption of the tail, for some reason or other, fails to act. The embryo of every higher vertebrate exhibits two aortæ, both of which normally persist in reptiles, but only the right persists in birds and the left in mammals. If in an embryo of the last the stimulus that causes the right embryonic aorta to undergo atrophy acts on the left aorta, the right instead of the left will persist in the adult.

As evolutionists do not believe mammals to have evolved from birds, it is not open to them to regard the presence of the right aorta in man as a case of reversion.

We have now to consider the other class of organs wrongly regarded as vestigial, namely structures homologous with those of other organisms but of unusual form.

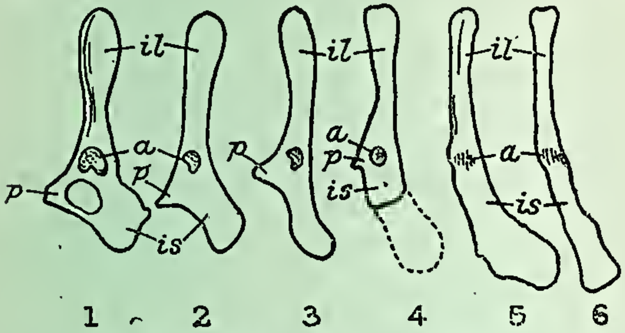

FIG. 3.—Pelvises of Sirenia. (After Abel.)

1. *Eotherium ægyptiacum*; 2, *Eosiren lybica*; 3, *Halitherium sehinzi*; 4, *Metaxytherium petersi*; 5, *Halicore dugong*; 6, *Halicore tabernaculi*.

a = Acetabulum. The socket in which the femur is inserted.
il = Ilium.
is = Ischion. } The three bones that make up each half of the pelvis.
p = Pubis.

Considerations of space render it impracticable to deal with all these. We will therefore discuss at some length the so-called rudimentary pelvis and hind limbs of the Cetacea and Sirenia which are cited as proof that these creatures evolved from terrestrial mammals.

Most of the aquatic mammals have, hidden in the body wall, a pair of small bones homologous with the pelvic (hip) bones of land animals; some have in addition tiny bones or cartilages homologous with the femur and tibia (leg bones).

Evolutionists believe that some terrestrial ancestor of each of these aquatic orders took to seeking food in the sea and then began to use the tail as a swimming organ. In time they became thoroughly aquatic; in consequence, the pelvis and hind limbs, being no longer of use, have gradually diminished in size, until to-day mere relics of them remain.

Professor O. Abel maintains that palæontology lends support to this view. Not that any fossil has been discovered intermediate between the Cetacea or the Sirenia and any land animal. As we shall notice (see p. 132), the earliest-known fossils and of whales and sea-cows exhibit all the characteristics of their respective orders.

Abel asserts that in the earlier Sirenians the pelvis is better developed than in the later ones, that the known fossils prove that it has undergone gradual but considerable degeneration since the Eocene.

He points out that the pelvis of *Eotherium* of the Middle Eocene—one of the earliest Sirenians known to us—bears some resemblance to that of an ungulate (hoofed mammal), that it exhibits an obturator foramen and an acetabulum or socket for the articulation of the thigh bone. From this he concludes that the Sirenia and the Ungulata evolved from a common ancestor. By selecting Sirenian fossils of various periods Abel has arranged a chronological series (see Fig. 3) of pelvises which appear to show progressive degeneration.

At first sight Abel's series seems to prove his case.

A little reflection, however, shows that this is not so:

1. In the Manatee (a Sirenian) the pelvis is unlike any of those in Abel's series and bears no resemblance to that of an ungulate (see Fig. 4). This fact is difficult to reconcile with the theory that all the Sirenia or sea-cows have descended from a common ancestor.

2. There is no proof that the later members of Abel's series have descended from the earlier. Indeed, *Eosiren* lived so little later than *Eotherium* as to allow insufficient time for the loss of the obturator foramen and the considerable reduction of the acetabulum; moreover, it is difficult to believe that degeneration resulted in the filling up of a hole in a bone.

The ischium of *Halitherium*, although more slender, is longer than that of *Eosiren*; it is therefore improbable that the former is derived from the latter. The pelvis is subject to considerable variation in the sea-cows; that of the male Manatee differs greatly from that of the female. This being so it is not safe to assume that the Dugong evolved from *Halitherium*.

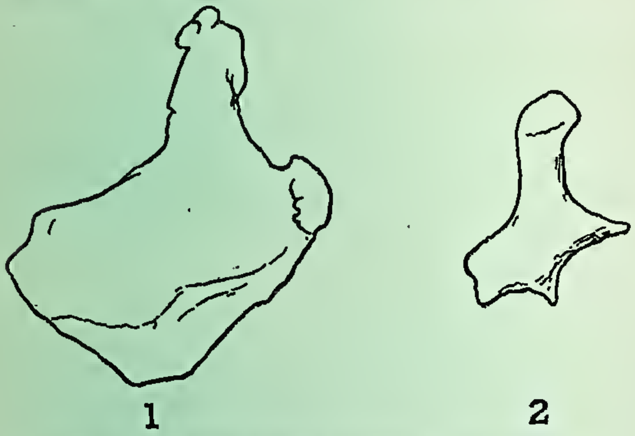

Fig. 4.—Left Halves of Pelvis of Manatee. (After Kraus.)
1. Male, 243 cm. in length; 2. Female, 246 cm. in length.

3. It is improbable that the great obturator foramen should have disappeared long ago from the Sirenian pelvis while the traces of the smaller acetabulum persist.

4. Fossil Cetaceans are known from the Early Eocene

onwards, but these do not show a progressive reduction of the pelvis.

5. The gradual transformation of a land animal into a whale or a sea-cow appears to be physically impossible, because the tail could not act as a propeller by vertical motion until the pelvis had been so reduced in size as to render locomotion on land impossible. If such transformation occurred gradually there must have been a long period when the ancestors of these aquatic forms, while yet poor swimmers, were unable to use the hind limbs for locomotion. How could such creatures hold their own in the struggle for existence? Yet, if the evolution theory be true, this apparently impossible transformation was effected twice over, i.e. in the case of the Cetacea and that of the Sirenia.

6. There are no known animals, living or extinct, intermediate between the whales and the sea-cows on the one hand and any land mammal on the other. Neither the otter shrew (*Potamogale*) nor the musquash (*Fiber*) are intermediate, although both swim well by means of the tail and are capable of locomotion on land. In their case the tail is moved from side to side in swimming, while in whales and sea-cows it is moved up and down; such vertical motion would be impossible in an animal having a large pelvis, because this last would prevent the necessary attachment of the great motor muscles of the tail to parts of the spine in front of the pelvis.

7. Some Cetaceans, e.g. the Gangetic Dolphin, show no traces of either pelvis or hind limbs; others exhibit a pelvis but no hind limbs; others have both. The reason of this cannot be that some forms have proceeded further along the path of evolution than others, because *the Cetacean most highly adapted to an aquatic existence*—

the Right Whale—*is the form in which the hind limbs are best developed.* Moreover, although the Sirenia are admittedly less completely aquatic than the Cetacea, none of the former but some of the latter exhibit bones homologous with those of the hind limb.

8. The position or orientation of the pelvis is not identical in the whales and sea-cows, being placed horizontally in the former and vertically in the latter. This is difficult to account for if the pelvis be a useless vestige.

The correct interpretation of the bones embedded in the body wall of aquatic mammals is that they are useful structures which are formed from the embryonic rudiments that give rise to the pelvis and hind limbs in land animals. It is because they serve one purpose in the whale and another in the sea-cow that they are differently placed in the two orders. As Vialleton points out [*Morphologie Générale* (1924), p. 391], the pelvic bone is placed vertically in sea-cows because their lumbar region is very short; the dugong has four lumbar vertebræ and the manatee but two, while the Cetacea have from six to twenty. Owing to the shortness of the lumbar region in the Sirenia the muscles of the abdominal wall, which take off dorsally in that area, run almost vertically; in consequence they would, when contracting, unduly squeeze the viscera but for the resistance offered by the vertically-placed pelvic bones. Owing to the greater length of the lumbar region in the Cetacea the abdominal muscles in that region run obliquely and do not tend to constrict the trunk when they contract; thus there is no need for the pelvic bones to be placed vertically and to be adpressed to the sacrum; they are placed horizontally at the genital orifice which they stiffen. The femur acts as an attachment for a group of muscles.

It may be asked: what is the significance of the mark in the sirenian pelvis designated by Abel the acetabulum? The answer is: this is merely the junction of the two bones of which the sirenian pelvis is made up. In terrestrial animals each half of the pelvis is usually composed of three bones, which meet in the area known as the acetabulum. Their growth is so regulated that they do not fuse strongly at the point of junction, which thus affords a convenient place for the formation of the socket for the head of the thigh bone.

In the embryos of aquatic mammals, as in those of all other higher vertebrates, the rudiments that give rise to the limbs appear in the form of papillæ or buds. In the Cetacea and Sirenia those of the fore limbs become paddles, those of the hind limbs either cease to develop, or give rise to the various small bones of which the uses have been explained above. Darwin exclaimed: "How inexplicable is the similar pattern of the hand of man, the foot of a dog, the flipper of a seal on the doctrine of independent acts of creation!" This reveals a failure to understand the mechanism of embryonic development. All vertebrates are constructed on a common plan—a plan capable of many variations. The embryonic rudiment of the fore limb may give rise to the hand of man, the foot of the dog, the flipper of the seal and the wing of the bat. What is inexplicable is how an ordinary leg could be gradually transformed into the wing of a bat and thousands of successive generations of organisms could hold their own in the struggle for existence while the transformation was being effected.

On the view of embryonic development set forth above are easily explained all the so-called vestiges which are nothing but unusual developments of a particular rudiment (*ébauche*) or area of the embryo, as, for example, the bones on either side of the vent embedded in the body wall of the python and some other snakes, the pineal body and the pinna of the ear of man. The pineal body is not a degenerate eye as evolutionists imagine. It is highly improbable that so useful an organ as an eye in the back of the head would be lost in the process of evolution; nevertheless evolutionists are forced to believe that such an invaluable organ has been lost on no fewer than three occasions.

There arises in the brain of every vertebrate embryo a rudiment (*ébauche*) which develops in some organisms into a sensory organ affected by light (in which case a hole develops in the skull above it), in others into a glandular structure; in a few it gives rise to no organ.

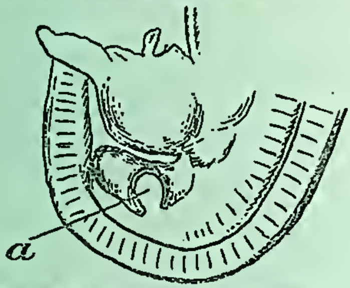

Fig. 5.—Tail End of the Embryo of the Whale, *Phocæna communis*. (After Guldberg.) × 16.
a. Hind limb.

The pinna of the human ear is not a useless relic of the external ear of a prick-eared ancestor, but an organ peculiar to man. The rudiment or region of growth (*ébauche*) that gives rise to the external ear is capable of developing into many kinds of ear; that of the horse presents one variety, that of man another.

Considerations of space render it impracticable here to deal further with the phenomena of embryonic development. Those interested in the subject are referred to any textbook on embryology. The non-evolutionary interpretation of the facts of embryology are admirably set forth in Vialleton's *Morphologie Générale* (1924) (Paris)—a work that well merits translation into English.

It is hoped that sufficient has here been said to refute the recapitulation theory and to demonstrate that the embryological phenomena cited as testimony favourable to the doctrine of evolution are more readily interpreted on the doctrine of creation, or abrupt origin.

Experimental biology appears to favour the latter. It shows that apparently insignificant stimuli effect far-reaching results. Thus Stockard [*American Journal of Anatomy* (1910), p. 369] has made the surprising discovery that the addition of a little magnesium chloride to the water in which eggs of the fish *Fundulus* are developing results in these giving rise to one-eyed fish.

Experiment shows that if secretion of the thyroid gland be injected into a tadpole that tadpole will develop precociously into a frog; on the other hand, if its thyroid gland be removed a tadpole will never metamorphose into a frog. Thus, apparently, a tadpole is unable to develop into a frog unless assisted by the secretion of the thyroid gland.

Properly interpreted, embryology would seem to teach that, if in the past an organism of one kind has ever been converted into an organism of another kind, the force or stimulus that caused the transformation acted on the developing embryo. Thus, if an ordinary mammal was transformed into a bat, the stimulus that led to this must have been applied to the embryo when only a few days old, because, from its inception in embryonic life, the rudiment of the fore-limb of the bat is unusually large and so bears the stamp of the wing.

It may here be repeated that the belief that new types were created by an act of God does not in any way check scientific investigation, any more than does the theory that they originated as the result of the action of "blind forces."

In the one case the man of science seeks to discover the method adopted by the Creator, in the other the nature of the forces at work. Take, for example, the case of the origin of the Amphibia. On either view of their origin the following questions arise: Has every vertebrate egg within it the power of developing limbs? Is the development or non-development of these merely a matter of stimulus? Did the first amphibians originate because in some fish-like organism the thyroid gland was created by the Creator or by blind natural forces? Is it possible to discover some stimulus which if applied to the embryo of a fish will cause it to grow limbs?

VII

SOME TRANSFORMATIONS POSTULATED BY THE DOCTRINE OF EVOLUTION

One of the maxims of science is that if any given phenomenon can be explained in two ways, one explanation invoking a miracle and the other invoking natural forces, the latter explanation should be adopted.

One of the reasons why the evolution theory was so readily accepted is that the theory of creation was supposed to involve the occurrence of miracles while the theory of evolution dispensed with them. It is submitted that the latter supposition is not justified. If the assertion that the whale is a separate creation involves a miracle, the assertion that the whale gradually evolved from some land animal appears to involve two miracles—a gradual transformation that appears to be physically impossible, and the preservation of a long line of succeeding generations of the animal in question during the transformation.

The theory of the gradual origin of every new type involves a number of transformations that are apparently physiologically or mechanically impossible.

Let us notice two or three of these.

1. The gradual transformation of an Amphibian into a Reptile.

In this connexion I take the liberty of quoting from a paper contributed by Dr. J. Needham to *Science Progress* (1929), Vol. 23, p. 63:

> "When the first reptiles left the sea, they were faced with two very difficult embryological problems. To begin with, they had to find out how to abandon metamorphosis; but, that accomplished, they had to discover a way of arranging a water-supply for their embryos. As Gray has shown, aquatic embryos always depend on their environment for a supply of water; in other words, the fertilized egg contains enough solid but not enough water to make the finished larva. The first terrestrial eggs, therefore, had to contain enough water as well as enough solid, and, as arrangements to prevent undue evaporation were essential, the closed-box system (i.e. the encasing of the egg in a hard shell) inevitably developed. The mechanism by which a constant pressure head of water was provided in the terrestrial eggs, namely the egg-white, can be seen functioning at the present time in the as yet unidentified acid which, introduced by the embryo's metabolism into the egg-white, as Vladimirow has shown, gradually brings the latter to its isoelectric points and liberates water by degrees from the colloidal albumen. All the economy of the successful terrestrial egg had to be directed towards conserving the water, and, while a great bath would have been required to keep the urea concentration down within bearable limits if all the nitrogen was secreted in that form, only 20 per cent. of the water need be set aside for handling uric acid."

Before, then, the habit of depositing eggs in water could be changed to that of laying them on the dry land, the following alterations in the egg had to be made: the formation of a tough shell to prevent evaporation of the liquid contents of the egg and to protect them from predacious creatures; the secretion of an acid to cause the white of egg to yield its water as required; a change in the metabolism (chemical changes in animals) of the embryo whereby the waste products take the form of insoluble uric acid instead of soluble urea; the introduction of a quantity of yolk to enable the embryo to remain in the egg until it reached a stage when it was able to fend for itself on land; the development of two special embryonic membranes—

the amnion and allantois—to protect the embryo, enable it to breathe, and act as a reservoir of the waste products resulting from its metabolism; the development of a tooth in the embryo with which to break the hard shell of the egg. Moreover, fertilization of the egg as soon as the shell evolved, had to take place within the female before the shell began to harden, necessitating changes in the uro-genital organs and habits of the adult.

Most, if not all, the above changes would be useless, or even harmful, until they were more or less complete; what, then, can have not only inaugurated them but caused them to continue until the transformation of an aquatic into a terrestrial egg was completed? The process, if gradual, must have taken a very long time, and how did the embryos contrive to survive during this long period of transition?

It is necessary never to lose sight of the fact that, while all the transformations postulated by the doctrine of evolution were being effected, the creatures being transformed, their eggs and their young had to live and compete with other organisms.

2. The gradual transformation of a Reptile into a Bird.

Birds, like mammals, are warm-blooded, while reptiles, amphibia and fish are not. In the latter the temperature of the blood is always the same, or nearly the same, as that of the surrounding medium, be this air or water. In warm-blooded creatures the temperature of the blood is constant, and, in all but the hottest climates, considerably higher than that of the surrounding air or water.

In temperate and warm climates the blood can be maintained at its normal temperature in birds and mammals only by the expenditure of much energy in the form of heat. In consequence, a warm-blooded animal requires a far greater quantity of food than does a cold-blooded one of the same size. Thus, the former is a less economical machine than the latter, and, owing to the greater amount of food it requires, is handicapped in the struggle for existence in comparison with a cold-blooded animal.

The difficulty in believing that natural selection did not eliminate all reptiles that tended to become warm-blooded may be overcome by supposing that the evolution took place in some part of the world where the temperature was constant and about that of blood-heat, but, even so, a heat-regulating mechanism would be necessary to prevent the individuals in question becoming overheated when pursuing their quarry.

It is the origin of this that presents the difficulty.

In the case of birds the heat-regulating mechanism is not fully understood. The feathering prevents undue dissipation of the heat generated by the chemical processes of the body. The spacious air sacs, which are organs peculiar to birds, probably assist in the dissipation of surplus heat generated during periods of great activity. But these alone would not suffice to maintain a normal temperature. There seems to be a special nervous mechanism which controls the oxidation of the tissues and regulates the blood supply to every organ.

It is difficult to believe that natural forces produced this mechanism just when it was required. Moreover, if the evolution doctrine be true, a temperature-regulating mechanism has been evolved at least three times over; in birds, in monotremes and in the higher mammals.

Further, the eggs of warm-blooded birds have to be kept at a constant temperature. In consequence, in cold and temperate climates, birds have to incubate their eggs, and, in very hot countries, to take precautions to prevent them being baked by the sun. Reptiles are under no such necessity. Incubation makes great demands on the sitting bird and exposes it to dangers to which the reptile is not subjected.

That warm-blooded creatures are far more active than cold-blooded ones, and are able to thrive in regions too cold for the existence of cold-blooded creatures, does not explain how the warm-blooded condition arose.

Feathers are structures peculiar to birds. According to the evolutionist, they evolved from reptilian scales. This is not easy to believe in view of the extraordinary complexity of a feather. There are models in the Natural History Museum at South Kensington illustrating its structure. Along each side of the shaft runs a series of thin plates or lamellæ, of which the broad surface is at right angles to the shaft. These lamellæ are known as barbs. Along each barb runs a double row of lamellæ—the barbules. Those on the near side of the shaft taper to a point, while those on the underside terminate in hooks. By means of these hooks the adjacent barbs are locked together and so give the feather its wonderful firmness and elasticity. Gadow estimates that some large feathers contain over a million barbules. This complicated structure is seen both in the flight feathers and those that cover the body.

It is still more difficult to believe that the fore leg of a land reptile or the fore paddle of an aquatic reptile, as the result of the action of natural forces, became gradually converted into a bird's wing—an implement that, in a fraction of a second, can be converted from a plane impervious to air into one through which air passes almost without resistance.

This transformation, however, presents no difficulty to some evolutionists.

> "From being a terrestrial runner," writes Heilmann [*Origin of Birds* (1926), p. 200], "the animal now turns an arboreal climber, leaping further and further, from branch to branch, from tree to tree, and from the trees to the ground. Meanwhile the first toe changes to a hind toe so adapted as to grasp the branches. As the hind limbs while running on the ground have abandoned their reptilian position, they are kept closer to the body when leaping takes place, the pressure of the air, acting like a stimulus, produces, chiefly on the fore-limbs and the tail, a parachutal plane consisting of longish scales developing along the posterior edge of the forearm and the side edges of the flattened tail.
>
> By the friction of the air, the outer edges of the scales become frayed, the frayings gradually changing into still longer horny processes, which in course of time become more and more feather-like, until the perfect feather is produced. From wings, tail and flanks, the feathering spreads to the whole body. The lengthening of the penultimate phalanges of the fingers is attained by using the claws for climbing, and this elongation has been very propitious to the subsequent development of the wing.
>
> The more intensive use of the arms, however, has also lengthened these, and laid claim to more powerful muscles for the movements of the same: this again has reacted on the breast-bone, the two lateral halves of which have coalesced and ossified completely, forming a projecting ridge for the origin of the muscles.
>
> The accelerated metabolic process, finally, produced an increased caloricity protected by the feathering until the warm-blooded state was attained."

The above does great credit to Mr. Heilmann's powers of imagination. Even if acquired characteristics be inherited, I am unable to believe that were a reptile, generation after generation, to spend twelve hours daily from the Cambrian onwards in leaping from tree to tree the result would be the evolution of wings and feathers.

Neither Mr. Heilmann nor anyone else, so far as I am aware, has attempted to explain why the wing of the pterodactyl (see p. 126) differs fundamentally from that of a bird: it lacks feathers and is membranous, the membrane being supported by an enormously elongated little finger.

Prima facie, then, it is highly improbable that a feather evolved from a reptilian scale, or the wing of a bird, a pterodactyl or a bat gradually evolved from an ambulatory or natatory fore limb.

Palæontology lends no support to the notion that such evolution has occurred; no fossils have been found exhibiting any structure intermediate between the scale of a reptile and a fully formed feather, nor any displaying a fore limb intermediate between that of an ordinary terrestrial or aquatic animal and a wing. The feathers of the earliest-known fossil bearing them—*Archæopteryx*—are as perfect as those of living birds; in the earliest-known fossils of pterodactyls and bats the wings are fully developed.

3. The gradual transformation of a Reptile into a Mammal.

According to Dr. Simpson (see p. 180), the transformation of a reptile into a mammal has been effected on no fewer than four independent occasions. Even if Simpson be mistaken in believing the Triconodonta and the Multituberculata to be mammals, the supposed transformation, if the doctrine of evolution be true, must have occurred on two occasions, i.e. when the monotremes were evolved and when the higher mammals arose.

In order to demonstrate how improbable it is that a reptile should have been gradually transformed into a mammal, all that is necessary is to consider some of the more important differences between reptiles and mammals:

1. In mammals each half of the lower jaw is composed of a single piece of bone; in reptiles it is made up of more than one bone.

2. In mammals the lower jaw articulates direct with the skull; in reptiles the articulation is through the intervention of the quadrate bone.

3. In mammals the ilium (part of the hip bone) projects forwards; in reptiles it projects backwards.

4. In reptiles the visceral cavity extends behind the hip, forming a pocket on either side of the intestine in which part of the kidney lies; in mammals the visceral cavity does not extend behind the hip. pectoral

5. The structure of the pelvic (hip) girdle differs fundamentally in the two classes. In reptiles it articulates with the sternum (breast-bone) by means of the coracoids, and forms part of the thorax; in mammals it does not. In consequence, the latter neither walk nor breathe in the same manner as the former. In reptiles the front part of the body is propped up on the fore limbs, in pronograde mammals it is, in the words of Professor F. G. Parsons, "suspended like a suspension bridge between the two scapulæ (shoulder-blades), the *serratus magnus* muscles form the chains of the bridge."

6. In reptiles the fore part of the thorax is rigid and incapable of expansion; in mammals, being formed by the first pair of ribs, it is expansible.

7. Complementary to the structure of the fore part of the mammalian thorax is the diaphragm—a fibromuscular partition separating the thoracic and abdominal cavities. Reptiles have no diaphragm, in consequence

they do not breathe as mammals do, their thorax is not a closed box, it is not alternately expanded and contracted. Sir Arthur Keith confesses his inability to comprehend how the mammalian diaphragm can have been derived from any reptile; hence, being an evolutionist, he is driven to conclude that mammals evolved directly from an amphibian (one of the Stegocephalia) [*Journal of Anatomy and Physiology* (1905), Vol. 39, p. 261].

8. In reptiles the ankle joint is between the two rows of ankle bones; in mammals it is at the root of the toes.

9. The muscular coat of the alimentary canal is furnished with a layer of longitudinal muscles and one of circular muscles in reptiles, birds and mammals. In mammals the longitudinal muscles are outside the circular muscles, in the other two classes they are inside them.

10. Reptiles have two aortæ; mammals have but one—the right.

11. In reptiles the red blood-corpuscles are nucleated; in mammals they are not.

12. Reptiles are cold-blooded; mammals are warm-blooded.

13. No reptile exhibits hair or fur; nearly all mammals do.

14. Mammals are provided with mammary glands—organs entirely unknown in reptiles.

15. In reptiles the chief nitrogenous excretory product of tissue waste is uric acid; in mammals it is urea.

16. The cheek teeth of mammals differ from those of reptiles in that they have more than one root and complicated crowns.

17. Mammals have in the ear a structure not found in any reptile. This is known as the Organ of Corti; it consists of a tunnel bounded on either side by a row of rods, having somewhat the appearance of the keyboard of a piano.

18. In mammals a series of three small bones—the malleus, incus and stapes—convey sound vibrations from the outer to the inner membrane of the ear; in reptiles this function is performed by a single bone—the columella.

19. In reptiles the ciliary muscle of the eye is striped; in mammals it is not.

20. The system of blood supply to the iris of the eye differs fundamentally in mammals and reptiles.

In order, then, to convert a reptile into a mammal, among the changes undergone must have been those necessary to bring about the above points of difference.

Some of these necessary changes do not present any insuperable difficulty; others do.

We have already dealt with warm-bloodedness.

The earliest-known mammals walked on land, as did the reptiles that are supposed to have given birth to them. What, then, can have caused some of these reptiles to change their manner of locomotion and adopt an entirely new method of breathing?

Is it credible that the longitudinal muscles of the gut of some reptile were gradually transformed into circular muscles and the circular into longitudinal?

What can have made the ciliary muscle of the eye of some reptile lose its striations?

Why should some reptile change the system of blood supply to its iris? What can have made the chemical processes in the body of some reptile alter so that the waste products were secreted mainly as urea instead of uric acid?

That all the above transformations should have occurred once is difficult to believe; that they should have occurred on more than one occasion seems incredible.

We have noticed that in order to convert an amphibian into a reptile its chemical metabolism must be altered in such a way that uric acid is secreted in place of urea. The transformation of a reptile into a mammal would involve a change in metabolism in the reverse direction. This would be a case of evolution retracing its steps, of reversed evolution.

Correctly interpreted, the facts of physiology and anatomy seem plainly to indicate that, at any rate, the larger groups of animals are independent creations, that is to say, have originated abruptly.

4. The gradual transformation of a Land Animal into a Whale.

We have already stated facts (see p. 61) which seem to indicate that such a transformation is impossible.

> "There is," writes Vialleton [*Morphologie Générale* (1924) p. 394], "no room for states intermediate between those of ordinary mammals and the fish-like mammals, for one cannot imagine individuals of which the posterior members are still fairly well (*assez*) developed and the tail already longer than usual, functioning simultaneously. . . . It is thus an illusion to seek for intermediaries which will exhibit at the same time the pelvis (hip bone) of an ordinary mammal and a tail tending towards the pisciform type. The two conditions exclude each other."

5. The gradual transformation of a Lower Animal into a Human Being.

Man is unique among animals. If we regard only his anatomy he is merely a family, now represented by one genus, of the Primate sub-order *Simioidea*, which includes monkeys and apes. If we take into consideration his psychic qualities it seems necessary to place him in a separate kingdom. That such an animal—one that lords it over all the others—should have arisen in the ordinary course of evolution is *prima facie* improbable.

His chief asset is his brain, which is far larger than is needful to enable him to hold his own against all other animals. What natural force can have caused his great brain to have developed?

On the other hand, while his brain was yet on the same level as those of the creatures from which he is supposed to have evolved, it is difficult to understand how he could have competed against powerful predacious animals. Physically he is no match for them. He is a comparatively poor climber. He is not so fleet of foot as most quadrupeds. His teeth and nails are contemptible weapons. He lacks protective armour. Owing to the hairlessness of his body he is more sensitive to changes of temperature than are most animals. His great assets—his brain and hands—would not suffice to set off his disabilities until they had attained considerable development. If he once possessed weapons of offence other than his brain and hands, why did he lose them? He needed them to fight against his fellow-men, and natural selection should have maintained their efficiency. If he evolved in some part of the globe free from large apes and carnivores, what led to the enormous development of his brain?

In view of these facts, it is difficult to believe that he gradually evolved from some other animal. Not only, then, does the doctrine of evolution seem to postulate impossible transformations, but creatures while undergoing these supposed transformations, being peculiarly ill-fitted to maintain themselves in the struggle for existence, should have been speedily exterminated by natural selection.

Natural Selection, although it established the doctrine of evolution, is a stumbling-block to the acceptance thereof!

VIII

SOME CHARACTERS OF ANIMALS APPARENTLY INCOMPATIBLE WITH EVOLUTION

Morphological, histological and physiological research has revealed the fact that most, if not all, organisms present features difficult to reconcile with the evolution theory.

The ratio between types and species in the various large groups of animals and plants does not seem to be in accord with it.

If every type be the result of the accumulation of variations or mutations, the more peculiar the type the greater must be the number of species intermediate between the type and the ancestral form, and the more types in any group the greater must be the number of intermediate species. Thus the doctrine requires that a group rich in types should invariably contain more species than one poor in types. In fact, the reverse is the case.

Fuchs has enunciated the following law: the number of species in each group is in inverse proportion to the number of types contained within it. Thus, the Crustacea and Mammalia are rich in types and poor in species; insects and birds are poor in types and rich in species. This is equally true of plants: the Smilaceæ, Rosaceæ and Liliaceæ are rich in types and poor in species; the Compositæ, Gramineæ and Leguminosæ are rich in species and poor in types.

According to Neumayer, 3,500 species of mammals and 13,000 species of birds were known in 1898, but the birds, despite their wealth in species, all fall into some five types: flying, terrestrial, aquatic, wading and nocturnal; whereas mammals display the following types: scampering, cursorial, graviportal, saltatorial, fossorial, natatorial, scansorial, brachiating, bipedal, volplaning, flying and nocturnal.

The Coleoptera (beetles) are a more homogeneous group than the Crustacea; nevertheless 120,000 species of Coleoptera were known in 1898 as compared with 8,000 species of Crustacea.

Another feature not easily reconciled with the evolution theory is the great disparity in the span of life of various animals.

If every organism be descended from a common ancestor, would such enormous differences exist? Why should a parrot live to over 100 years (there is a record of 116 years) while the pheasant apparently does not live longer than 15 years; why should an elephant live for as much as 120 years while no rhinoceros is known to have lived more than 37, and no hippopotamus more than 33 years; why should the cat live three times as long as the guinea-pig?

As the vast majority of individuals in a state of nature are killed long before they have reached their full span of life, and as species the members of which are long-lived do not seem to be more flourishing than those of which the members are short-lived, it does not seem possible that the disparity in longevity has arisen as a result of natural selection.

Moreover, if the doctrine of evolution be true, there should be an intimate connexion between kinship and longevity; the more nearly allied two animals be, the less difference should there be in the duration of their lives. No such connexion exists. As Pearl remarks [*Biology of Death* (1922)]: "The differences between distinct groups of animals (species, genera, families, etc.) in respect of life-span stand in no generally valid orderly relationship to any other broad fact now known in their structure or life-history."

If, however, the various types have been created independently, we should expect this disparity in the span of life, because the *raison d'être* of these types is the stocking of the earth with a great variety of forms, and length of life is a characteristic that offers ample scope for variety.

Akin to the disparity of longevity is that in the length of time during which genera and larger groups of organisms have persisted on the earth. Some great groups make their entrance and exit in the same geological period; others live through several. Examples of short-lived groups are the Trilobites, Ichthyosaurs, Pterodactyls and Dinosaurs.

On the other hand, a number of genera now living are known to have existed as early as the Ordovician or the Silurian period: the Foraminifers *Lagena* and *Rotalia*, the Brachiopods *Lingula*, *Crania*, *Leda*, *Nucula* and *Acmæa*, the Gastropod *Nautilus*, the Crustaceans *Bairdia*, *Cytherella* and *Cypridina*.

The explanation of the long persistence of these creatures cannot be that the conditions under which they exist have undergone little or no change, because thousands of genera that lived side by side with them have become extinct.

> "For the extinction of many plants (Sigillaria, Lepidodendron, Cordaites) and animals (Blastoids, Tetracoralla, Trilobita, Rudistæ, Ichthyosaurs, etc.) of former periods no adequate explanation has yet been found," writes von Zittel [*Textbook of Palæontology*

(1913), Vol. I, p. 15]. "Changes in external conditions, especially as regards the distribution of land and water, climatical conditions, saltness of the water, volcanic eruptions, paucity of food supply, the encroachments of natural enemies, and diseases may have led to the extinction of certain forms, but such . . . signally fail to account for the disappearance of entire species or particular groups of organisms. Oftentimes extinction seems to have been caused merely by superannuation."

These enormous differences in the longevity of groups fit ill the doctrine of evolution, but, if each type be a special creation, we should expect an attribute of some types to be the power of long persistence.

Probably no organism exists that does not display some anatomical features very difficult to reconcile with the doctrine of evolution. Let us notice a few examples of such features. Many of the adaptations exhibited by organisms are of such a nature that their gradual evolution seems impossible.

Coaptations. Coaptations are the reciprocal adjustments of two independent parts of an organism so that they fit into one another as the blades of a pocket-knife fit into the handle. Cuénot cites a number of these in *L'Adaptation* (1925). One of them is the apparatus, resembling the press-button and socket of a glove, that fastens the mantle of a cuttle-fish in such a manner that the water expelled by the contraction of the mantle is forced out through the funnel thus formed and so propels the animal through the water. The hooks and barbules of the feathers of birds (see p. 71) afford another example.

Even if the effects of use and disuse can be transmitted to posterity (which has not been proved), it is difficult to understand how these coaptations can have evolved gradually. Cuénot writes:

> "The extreme mechanical perfection of these little appliances excludes accident; they are as refined in their structure as they are precise in their function. From all the evidence it cannot have been a fortuitous germinal mutation that caused the sudden appearance of a press-button and its socket. . . . Without any doubt coaptation is the end of a directed evolution. . . . But the only directive factor we know is Darwinian selection; it would be necessary for this to play the part of the workman correcting and gradually perfecting by successive fumblings; . . . but even if its omnipotence be admitted, selection could not create the co-ordinated details of coaptations, and it is precisely the origin of these details that it is difficult to comprehend. . . . But after these negations nothing remains. It would be a pure metaphysical amusement to imagine inside the organism a tiny whimsical demon, regulating and directing mutations, even if he were decorated, as some would decorate him, with pompous names: innate tendency to become perfect, vital *élan*, entelechy, etc. We must once again resign ourselves to saying: *Ignoramus*."

It should be borne in mind that many of these coaptations would be altogether useless until they were fully, or nearly fully, developed. Although so difficult to reconcile with the theory of evolution, coaptations are precisely what the doctrine of creation would lead us to expect.

Darwin was much addicted to pointing to facts "inexplicable on the ordinary view of the independent creation of each species." To-day the boot is on the other leg; it is possible to point to thousands of facts that appear to be inexplicable on the Darwinian view of evolution.

Mutual Adaptations. Some mutual adaptations, that is, complementary adaptations in two individuals, are of such a nature that they must have come into being before they were required. Cuénot calls these Preadaptations.

If mammals evolved from reptiles or amphibia, both mother and young of the nascent mammal had to be pre-adapted to the mammalian mode of nourishing the young.

In marsupials and placentals the mammary glands are provided with nipples; these would be useless unless the young possessed soft muscular lips—organs unknown in reptiles.

At birth a young kangaroo is little more than an inch long; it is blind and incapable of sucking; its fore-limbs are considerably longer than the hind and are provided with well-developed claws. When the youngster emerges from the mother's uro-genital sinus, it climbs, with the aid of its clawed forepaws, into her pouch. On reaching the teats it seizes one with its lips. The tip of the teat then swells so that it cannot be pulled out of the mouth without the exercise of considerable force. Further, there is a sphincter muscle round the mouth of the baby kangaroo to enable it to grip the nipple firmly. Although, owing to these pre-adaptations, it can grip and hang on to the nipple, it has not sufficient strength to suck; accordingly, the mammary gland of the mother is furnished with muscles that force milk into the gullet of the young one. In order that none of the milk so injected shall enter the windpipe and the youngster may breathe while it is being fed, its windpipe is prolonged upwards and forwards to fit into the back of the nasal tunnel. To prevent milk escaping by the sides of the mouth, these are closed, and, for a time, the mouth does not enlarge with the growth of the rest of the body.

None of the above pre-adaptations would be of much use apart from the others or until all were well developed. How, then, can they have originated gradually?

The pre-adaptation of the mother whale and her calf are not less complicated. No gradual transition is possible from suckling the young in the air to suckling them under water. On the first occasion when the young one was suckled under water both mother and calf had to be adapted to the operation. The windpipe of the calf is modified like that of the baby kangaroo, while the nipple of the mother is surrounded by a pocket that fits tightly over the snout of the youngster and so prevents salt water being imbibed along with the milk.

The Distribution of Anatomical Characters.

The doctrine of evolution teaches that all the members of an order, or any other group, have descended from a common ancestor. The characters common to all the living members of any group must have been inherited from the common ancestor; those that occur in some only of the members must have been subsequently acquired or be ancestral traits that have been lost by those members of the group in which they are lacking. To take a hypothetical case, A, the common ancestor of a group, gives off descendants that evolve in different directions; one line results in the form B having a hairy integument and the other in the form C having a woolly body covering. B and C each give off lines of descent which evolve differently; in the B or hair-covered line certain characters appear which we may call a, b, c, d, e, etc., and in the C or woolly line other characters arise that may be designated v, w, x, y, z. Among the living descendants of A only the hairy forms should exhibit the characters a, b, c, etc., and only the woolly ones the characters v, w, x, etc. In no organism should the a, b, c, etc., and the v, w, x, etc., characters be mixed. Therefore, by means of these characters there should be no difficulty in classifying the living members according to their descent.

In nature we do not find the characters of the members of any group distributed in this way.

Take man as an example. He is said to have evolved from some primate. At a comparatively early stage the prehensile-tailed New World monkeys were separated from the Old World monkeys. Man is supposed to have descended from some member of the latter group. This being so, he should not exhibit any of the characters of the New World monkeys, but should possess a number of those of the Old World monkeys. But Sir Arthur Keith has shown, in the article on *Man* in the *Encyclopædia Britannica* (1929), that man exhibits 5 per cent. of the characters of New World monkeys and 5 per cent. of those of Old World monkeys. Thus the evolutionist is obliged to believe that each of the characters shared by man and the New World monkeys has evolved independently on two occasions.

Nor is this all: taking a large number of selected points, 9 per cent. of these occur in man, gorilla and chimpanzee, but in no other animal. 5 per cent. man shares with the orang alone and 8 per cent. with the gibbon alone.

This, again, is not in accord with the theory.

Keith writes: "From the details revealed by anatomical analysis it is plain that evolution has not proceeded in an orderly or simple manner in shaping the bodies of the higher primates: characters are curiously scattered." In order to account for this the evolutionist is forced to believe either that the characters shared only by man and the orang have been lost by the chimpanzee and the gorilla, or that all these characters have evolved independently in man and in the orang, and that the structural features shared by man and the gibbon have been lost by all the other anthropoids or have evolved twice over—once in the gibbon and once in man.

Every other group of organisms of which the comparative anatomy has been carefully studied exhibits similar features.

A survey of the anatomical characters of any group seems to indicate that there are, so to speak, available certain types of each organ and that these types are distributed among the various families in such a way as to produce the maximum variety with the material available.

This is well shown by birds, the curious distribution of some of the structures of which are considered in Appendix II.

The distribution of tracheæ and nephridia is difficult to reconcile with the doctrine of evolution.

The Distribution of Tracheæ.

Tracheæ are tubular infoldings of the integument kept open by a spiral thickening of the wall. They constitute the breathing organs of Peripatus, the millipedes, centipedes, insects, spiders, scorpions and the land crustaceans known as wood-lice.

The presence of tracheæ in such various groups can be explained on the evolution theory only by assuming either that all the groups in question have descended from some land animal that lived in pre-Cambrian times, or that tracheæ have evolved independently on more than one occasion. Both assumptions seem to be untenable. As regards the first, Dr. W. T. Calman writes [*Encyclopædia Britannica* (1929), Vol. 2, p. 459]: "The suggestion that all-existing arthropods can have been derived from tracheate air-breathing ancestors . . .

cannot be considered seriously in the present state of our knowledge."

Moreover, the suggestion leaves the origin of the "lung-books" of scorpions unaccounted for.

Hence the other alternative is generally accepted. A. Willey writes [*Convergence in Evolution* (1911), p. 148]: "For more than a quarter of a century it has been recognized that the Tracheate Arthropods could not be reduced to a common standard and it has also come to be realized that the tracheæ of Insects and Arachnids have had separate origins and are therefore different morphologically though similar histologically and physiologically." Thus the doctrine of evolution appears to entail the belief that complicated organs in every way identical have gradually evolved from something else on more than one occasion.

Distribution of Nephridia.

The nephridia (excretory organs) of such very different forms as the Lancelet (*Amphioxus*) and the Polychæte worms are in every way similar in structure, being ciliated tubes that end blindly in branches furnished with vibratile flame-cells or solenocytes. As there are insuperable objections to the view that the animals named above have descended from a common ancestor possessing nephridia of the above description, evolutionists are apparently compelled to believe that these complex structures evolved independently on two occasions. Tracheæ and nephridia are by no means the only examples of identical structures found in widely separated groups. In order to explain the existence of all these the doctrines of parallel or collateral and convergent evolution have recently been formulated.

Such doctrines have the appearance of attempts to bolster up the evolution theory which is collapsing under the strain imposed by new anatomical discoveries. The position into which evolutionists have been driven is thus described by Professor Wood Jones [*Man's Place among the Mammals* (1929), p. 213]:

> "In Darwin's day it appeared beyond belief that the processes that he claimed to be responsible for producing evolution could ever have resulted in the formation of an organ so complex in its perfection, so useless in any stage short of perfection, as the eye. With the more plastic views of evolution . . . (now prevailing) . . . but little astonishment is caused to-day by the knowledge that eyes have been developed several times over in complete independence. . . . It should not therefore unduly strain our scientific credulity to imagine that an animal conforming to the popular conception of a monkey has developed twice. Indeed, when we consider the extinct Lemur, *Mesopropithecus*, we may even have to admit that it came near to being developed three times. To some it may seem impossible that a creature so complex, so definitely showing incipient human characters, could have been developed more than once, and that animals so superficially alike as the Spider Monkeys and the Woolly Monkeys on the one hand and the Langurs and the Gibbon on the other, had evolved in utter independence from a probable pre-Tertiary ancestor, which still retained many insectivore-didelphian characters and was little better to look at than a Tree-shrew. Yet, if comparative anatomy is capable of affording any evidence concerning the kinship of animals, there can be no reasonable doubt that every striking simian character found within the two phyla of the Platyrhines and Catarrhines (Old and New World Monkeys) has been independently developed as part of the phenomenon of convergence."

Professor Woodward holds similar views: he writes: "Apparently the same family or genus or species may have originated more than once from a separate series of ancestors."

Thus, according to some evolutionists, structural resemblance is no guide to relationship; two animals, so similar that both appear to belong to the same genus, may be in no way nearly related!

Mammary glands are organs peculiar to mammals. Living mammals are divided into three sub-classes—the Monotremes (egg-laying mammals), Marsupials (pouched mammals) and Placentals (all the higher mammals). If all three sub-classes be descended from one ancestral species of mammal they must have inherited their mammary glands from this ancestor and any differences in the glands of living forms must be the result of subsequent evolution.

The milk glands of the monotremes (*Ornithorhynchus* and *Echidna*) differ fundamentally from those of the other two sub-classes. In the former these glands are branched tubular; in the latter they are alveolar. Thus one kind cannot possibly have been gradually converted into the other, and the evolutionist is compelled to believe that a creature having all the features common and peculiar to all mammals evolved twice over in complete independence, that parallel evolution resulted in the separate origin of the monotremes and the other mammals.

The milk glands of monotremes are not provided with nipples; those of all other living mammals are. These nipples are not all of the same nature. They fall into two classes, known as "true" and "false" nipples, according to the manner in which they develop in the embryo. True nipples are formed by the pushing up of the area—known as the milk pocket—into which the milk ducts open; false nipples are formed by the raising up of the margin of the milk pocket to form the milk canal into which the milk flows from the ducts.

If true nipples were confined to one sub-class of mammals and false to the other, it would be open to evolutionists to assert that the milk glands of the common ancestor of the marsupials and placentals were devoid of nipples and that in the course of evolution true nipples developed in one sub-class and false in the other. But the true and false nipples are not thus distributed. The former occur in all marsupials and in the primates and rodents among placentals. All the other placentals appear to have false nipples. The nature of the two kinds of nipples is such that it is impossible for one kind to have been gradually converted into the other. An intermediary between the two is unimaginable. Unless, then, each kind of nipple had a sudden origin, either true nipples have evolved independently on two or three occasions or the placentals having true nipples evolved independently of those having false nipples.

From the foregoing it is apparent that increased knowledge of comparative anatomy has necessitated considerable modifications of the doctrine of evolution. Formerly the ways of evolution were believed to be straightforward; now they are described as "obscure and peculiar."

IX

THE TESTIMONY OF THE FOSSILS

GEOLOGICAL investigation has revealed the existence of a series of stratified rocks composing the crust of the earth. These strata have been formed successively, largely by the agency of water. As the chronological order of the series is known, they, in the words of Dawson, constitute "physical monuments of the earth's history."

The laying down of these strata occupied millions of years. In the present state of our knowledge we can make only a rough guess at the length of time. The prevailing opinion to-day seems to be that some 500,000,000 years have elapsed since the beginning of the Cambrian period. At the beginning of this volume is a table giving the names, order and comparative length of the various geological periods.

From the commencement of the Cambrian period onwards these strata of the earth's crust are rich in fossils, i.e. the remains or traces of animals and plants that lived at the time each stratum was deposited.

Thanks to these fossils, we are acquainted with the nature of the fauna and flora of every geological age of which the deposits have been preserved. If evolution has taken place the fossils must disclose this.

We have noticed that there are several objections to the doctrine of evolution; it involves the belief that in the past organisms have undergone transformations that appear to be physically and physiologically impossible; many animals exhibit characteristics very difficult, if not impossible, to reconcile with the doctrine. Moreover, the evidence we have considered seems to indicate that the changes that can be effected by a process of gradual evolution are confined to the limits of each family.

The above considerations, however, cannot prevail in face of evidence that in the past apparently impossible changes have been effected gradually in organisms. If the fossils show this, the doctrine of evolution must be accepted. Palæontology must have the final word. The fate of the doctrine depends on the testimony of the fossils. Their testimony, far from contradicting the evidence we have already considered, coincides with it in a remarkable manner.

The evidence of the fossils is not yet fully known, but so far as we know it, it does not make undue demands on our credulity; it does not, for example, compel us to believe that some species of land animal has been transformed gradually into a whale or a sea-cow. At the time of the resuscitation of the evolution theory our knowledge of extinct animals and plants was far smaller than it now is. The comparatively little then known of them seemed to be in accord with the theory. The highest animals—the vertebrates—and the highest plants—the flowering plants—do not occur in the oldest fossil-bearing layers. The earliest known fossils of vertebrates are those of creatures deemed to be more primitive than true fish, the true fish do not appear until later; later still the amphibia and reptiles show themselves, and yet later the birds and mammals. This fits in well with the theory that vertebrates gradually evolved from an invertebrate, amphibia from a fish, reptiles from an amphibian, birds from a reptile, and mammals from a bird. The earliest evolutionists believed that evolution had taken this course and they pointed to the duck-billed platypus, that lays eggs but suckles its young as a living remnant of an early mammalian fauna that had evolved from some bird.

Darwin and his followers confidently expected that every new fossil would furnish fresh evidence of the truth of their theory. This expectation has not been realized. The thousands of fossils discovered since Darwin revived the evolution theory are on the whole very unlike those evolutionists hoped to find. Many of them have proved most difficult witnesses; in order to make their testimony fit in with the theory this last has had frequently to be modified. Despite this, despite very ingenious attempts to explain away features of newly-discovered fossils unfavourable to the theory, Palæontology cannot be regarded other than as a hostile witness. Unless its testimony be greatly modified by yet undiscovered fossils the evolution doctrine will have to be greatly modified, or supplemented by a theory of abrupt origins.

If the truth must be told, the fossils that were known at the time of the resuscitation of the evolution theory were not really favourable to it. It is significant that the theory was not revived by a palæontologist. It was not forced upon unwilling biologists by the fossils they had discovered. Neither Darwin nor Wallace was a palæontologist. Of the palæontologists of Darwin's day only two, d'Hallory and Keyserling, accepted the theory of evolution. All the others were strongly opposed to it:—Cuvier—the greatest of them, d'Orbigny, Forbes, Woodward, Williamson, Murchison, Pictet, Falconer, Miller, Agassiz, Barrande and d'Archaiac. The generations that followed these, although caught up by the great tide of evolutionary enthusiasm, were but lukewarm adherents.

Thirty years ago, von Zittel, after the completion of his great systematic work on animal fossils, wrote:

> "The theory of descent has introduced new ideas into descriptive natural history, and has assigned to it a more noble name. But we must not forget that it is at present only a theory, which requires to be proved. I have endeavoured to show what interesting proofs have been brought to its support by palæontological researches, but I ought not to conceal the great gaps in our demonstrations."

The proofs of which von Zittel speaks relate only to slight changes. Some ten years later another palæontologist, Dépéret, wrote [*The Transformations of the Animal World* (1909), p. 113]: "The keenest partisans of the descent theory must acknowledge that the fossil links between the classes and orders of the two kingdoms exist in infinitesimal small numbers." While palæontologists were making pronouncements of this kind, anatomists were asserting that evolution is a law of nature, fully proved and no further evidence in support of it is needed!

The reason why the present generation of palæontologists are evolutionists seems to be they were taught from boyhood that evolution is a law of nature and that the only alternative explanation of the organic world is that species are immutable, which experiment and fossils disprove. Moreover, the lectures to which they listened and the textbooks they read make much of the fossils that appear to favour the doctrine of evolution and often pass over in silence those that are unfavourable to it, and make light of the poor support fossils give to the theory, by asserting that the known fossils constitute only a minute fraction of the living organisms of the past, therefore we cannot expect palæontology to afford anything like proof of the doctrine. We shall endeavour to demonstrate that the last assertion is not correct.

If the evolution theory be true, whenever a new group of animals (phylum, class, order, family or genus) arises, all the individuals that at first represent it must belong to the same species, because *ex hypothesi* it originated as the result of changes in one particular species. This being so, all the fossils of the group that occur in its earliest horizon must be of one species only. If the fossils of this first species of a new group be traced upwards through the earth's crust, as we pass from horizon to horizon we ought to find that the fossils of this species undergo slight changes in one direction, or more, until we reach a horizon in which some fossils of this original species, as the result of accumulated inherited variations, have become so different from the original form as to constitute a new species. At this horizon the group in question ought to be represented by fossils belonging to two species—the parent and the daughter. As we trace the fossils of these two species upwards we ought to notice in the case of each slight changes, until we reach a horizon in which the group in question is represented by three or more species. In yet higher horizons, as the result of similar changes, we might expect to find the group represented by several species, one of which may differ sufficiently from the parent species as to be deemed a new genus. At this horizon the group in question ought to be represented by two genera—the parent and the daughter, the fossils of the former belonging to several species and those of the latter to but one. The new genus thus evolved ought, at its inception, to be represented by a single species. If we continue to follow upwards the fossils of members of these two genera, we ought to witness the gradual origin of a third, and, perhaps, a fourth and a fifth, genus, and to find at a certain horizon a species of one of these genera differing so greatly from the parent species as to require it to be placed in a new family. By this time some of the earlier species may have become extinct. At this horizon the group, which will have been in existence many thousands of years, ought to be represented by fossils belonging to two families—the parent and the daughter, the latter ought to be represented by a single species, and the former to be composed of a large number of species and several genera. As the single species of the new family has gradually evolved from a species of the original family the line of demarcation between the parent and the daughter family must be very fine; in fact, the two families should be connected by a series of fossils, of which it is difficult to say to which family some belong. If we trace still further upwards the fossils of the group in question we may witness the birth of a new order, which in the horizon in which it first appears should be represented by but one species differing very little from the species of the original order from which it evolved. Still higher up we may come upon a fossil of the group in question which is so unlike the parent species of the group as to be deemed a member of a new class. This new class should be represented in the horizon in which it first appears by a single species which will differ only slightly from the species of the original class from which it evolved.

From the foregoing it is apparent, if the evolution theory be true, that—

I. Every group, that is, every class, order, family and genus, to be evolved must make its appearance in the form of a single species; it will not exhibit any considerable diversity until it has been in existence for a long period.

II. The fauna and flora of any given horizon should differ only slightly from those of the horizons immediately above and below.

III. It should be possible to constitute, from the fossils known to us, series illustrating, step by step, the origin of most of the classes, orders and families of animals and plants. By means of these fossil series it should be possible to draw up a pedigree tracing the descent of most, if not all, living species from some group that existed in the Cambrian. As our knowledge of the fossils contained in the crust of the earth is far from complete there would be gaps in most, if not all, of these pedigrees, but, despite such lacunæ, we ought to be able to trace with tolerable accuracy the descent from Cambrian forms of a considerable percentage of living organisms.

IV. The earliest fossils of each great group should have some only of the characteristics of the group, they should also exhibit some of those of the group from which they evolved, and the characters of the new group displayed by them should be comparatively poorly developed; thus, in the earliest fossils of bats the wing should be ill-developed in comparison with that of later forms, the earliest fossils of aquatic animals should be poorly equipped for life under water in comparison with later members of the groups to which they belong.

These conditions, however, are not fulfilled; new classes and orders often appear in the earth's crust, not as a single species, but in great variety. It frequently happens that the fauna and flora of a horizon differ very markedly from those of the horizon immediately below.

The genealogical series of fossils it is possible to arrange are generally short and the differences between the first and last members of each series are always inconsiderable.

When we trace backwards the lines of descent of two closely-allied living forms, these lines, instead of converging and meeting in a common ancestor, seem to follow a parallel course.

It is not possible to draw up a pedigree showing the descent of any species, living or extinct, to an ancestor belonging to a different order.

The earliest-known fossils of each class and order are not half-made or half-developed forms, but exhibit, fully developed, all the essential characteristics of their class or order. Any changes undergone by a great group after it has appeared are comparatively insignificant.

We will now adduce facts in support of each of the above statements.

New classes and orders often appear in the earth's crust, not as a single species, but in great variety.

In the earliest fossil-bearing deposits—the Cambrian—we find a most varied fauna. All the great phyla that compose the animal kingdom, with the single exception of the vertebrates, are represented at that period by fossils belonging to numerous classes and orders.

In higher strata new classes and orders belonging to these phyla appear for the first time; some of them make their *début* in the manner in which they should if the evolution doctrine be true, i.e. in the form of a single species. The majority, however, appear suddenly in great variety, which is not in accordance with the doctrine.

In the Ordovician appear suddenly:

(1) The Crinoidea (Sea-lilies), a class of the phylum Echinodermata. Not a single Crinoid fossil has been

found in the Cambrian, but in the Ordovician we find Crinoid fossils representing no fewer than fourteen families and three of the four orders that constitute the class.

(2) Four of the five orders of the Bryozoa or Polyzoa, represented by nineteen families.

(3) Ten new families of Pelecypod Molluscs.

(4) Nineteen new families of the order Nautiloidea of the Cephalopod Molluscs (of which the pearly Nautilus is a living example).

(5) Fourteen new families of the Trilobita, an extinct order of the phylum Arthropoda.

The phylum Vertebrata makes its appearance in the Upper Silurian in considerable variety, two classes of the eight that compose it being represented by fossils, namely, the extinct *Ostracodermi* and the *Elasmobranchii*, to which class the sharks and dogfish belong. The *Ostracodermi* is composed of four orders, of which three appear in the Silurian.

The Ammonites (an extinct order of Cephalopod Molluscs) appear in the Devonian in great variety, the fossils belonging to no fewer than nineteen families. In the same period appear two of the three sub-classes into which the *Pisces* (fish) are divided.

In the Carboniferous appear:

(1) The class *Insecta* in great variety, its fossils at that period representing no fewer than twelve orders.

(2) Three of the six orders that compose the class *Amphibia*, the *Labyrinthodontia* appearing a little before the other two orders.

(3) Two orders of the class *Reptilia*—the *Seymouriamorpha* and the *Pelycosauria*. These are now extinct.

In the Permian six new orders of reptiles make their appearance

In the Trias appear:

(1) Ten new families of Pelycopod Molluscs.
(2) Six new families of Gastropod Molluscs.
(3) Seventeen new families of Ammonites.

In the Jura appear:

(1) Two new orders of *Echinoidea*, represented by nine families.

(2) One new order of Crinoids, represented by eight families.

(3) Twelve new families of Pelycopod Molluscs.
(4) Fourteen new families of Gastropod Molluscs.
(5) Twenty new families of Ammonites.
(6) Eight new orders of Insects.

(7) Two new orders of Amphibians—the *Anura* (frogs) and the *Urodela* (newts).

(8) Three new orders or sub-classes of Mammals.

In the Eocene appear twenty-seven new orders of Mammals.

The abrupt appearance of all the above groups in great variety, while altogether in accord with the theory of creation, is not what would be expected if the doctrine of evolution be true.

It often happens that the fauna and flora of a horizon differ very markedly from those of the horizon immediately below.

The statistics given above of the sudden appearance of many groups of animals suffice to demonstrate the truth of this assertion; but these sudden additions to the fauna that occur periodically do not represent the whole of the changes that have occurred. It often happens that the apparition of a multitude of new forms is preceded by the disappearance of many of the older groups, as if these last had been wiped out by some catastrophe and new forms had been created to take their place.

Some idea of the extent to which one fauna has been replaced by a very different fauna may be gathered from Tables Nos. I and II.

TABLE I

Showing the Most Remarkable Replacements of Invertebrate Faunas

Name of Group.	Number of Families Living in the Carboniferous.	Number of Families Living in the Jurassic.	Number of Families Common to the Two Periods.
Crinoidea	16	9	Nil
Echinoidea	5	10	1
Other Echinoderms	18	8	1
Ammonoidea	12	22	Nil
Nautiloidea	15	2	Nil
Cephalopoda	27	28	Nil
Insecta	12	17	1

TABLE II

Showing the Most Remarkable Replacements of Vertebrate Faunas

Name of Group.	Number of Orders Living in the Permian.	Number of Orders Living in the Jurassic.	Number of Orders Common to the Two Periods.
Amphibia	3	2	Nil
Reptilia	9	8	Nil
	Number of Orders Living in the Jurassic.	Number of Orders Living in the Eocene (Tertiary).	Number of Orders Common to the Two Epochs.
Mammalia	4	20	Nil
	Number of Families Living in the Basal Eocene.	Number of Families Living in the Oligocene.	Number of Families Common to the Two Epochs.
Placental Mammals	14	61	3 (all belonging to the Order Insectivora)

This replacement of faunas is not confined to orders and families; it extends to genera. Some idea of the amount of replacement of these last may be obtained from the following statistics regarding the Crinoids, which, like most of those embodied in the above tables, have been compiled from the information given in von Zittel's *Textbook of Palæontology*.

Fossils of 34 genera of Crinoids are known from the Ordovician and 51 from the Silurian, of these only 4 are common to the two periods. In the Devonian fossils of 56 genera occur, of which only 12 are common to this period and the Silurian. In the Carboniferous fossils of 72 genera occur, of which only 15 are common to this period and the Devonian. Every one of the 72 Carboniferous genera seems to have become extinct by the Permian, in which fossils of 2 new genera occur. These latter disappear and are replaced by 5 new genera in the Trias, of which one persists until the Eocene and one is still living. In the Jura 14 new genera appear, of which only 6 live on into the Cretaceous.

The natural interpretation of the above facts is that in the past there have been at intervals creations of large numbers of organisms.

d'Orbigny, after he had studied and arranged 1,800 fossils, came to the conclusion that "from the first to the latest epoch of the animated world we see appear at all points of it, at one and the same time, a great multitude of different species belonging to all branches of the animal kingdom, of which there are no signs in the preceding periods." He was of opinion that in the past there have been twenty-seven distinct creations, each creation occurring after the previous one had perished.

He recognized that in the strata peopled by a later creation a few fossils of previous creations occur. He regarded the rare forms found in two stages of the earth's history as those that had perchance survived the catastrophe, or, more usually, as dead shells that had become mixed with the littoral fauna of a later stage.

The number of forms that persist through several stages (we have noticed some on p. 82) seems too large to be thus accounted for. Nevertheless, as Dépéret remarks, the observations of d'Orbigny are "exact in their broad lines, and the sudden replacing of marine faunas when passing from one stage to another, or even from one zone to another, must be considered almost a general rule."

The genealogical series it is possible to arrange are usually not very long and the difference in form between the first and last members of each series is always inconsiderable.

> "It is possible," writes Dépéret [*The Transformations of the Animal World* (1908), p. 268], "to constitute by the aid of fossil animals many *series of forms*, whose different terms or *mutations*, taken step by step, stage by stage, and even zone by zone, are linked to one another by almost imperceptible transitions. . . . If we confine ourselves to the comparison of immediate mutations, the differences which separate them are very slight and appear to be too insignificant to deserve to be distinguished as species. But, if we pass over a certain number of these intermediate forms . . . we notice differences important enough to justify the separation, not only of species but sometimes even of perfectly legitimate genera. . . . It is true—and this remark is important—that the species and genera thus formed by the direct and normal evolution of a branch always remain very closely related to each other and do not present differences considerable enough for them to be ranked as distinct natural families."

In other words, *it is not possible to arrange a genealogical series of fossils proving that any species has in the past undergone sufficient change to transform it into a member of another family.* All the changes proved by fossils to have taken place in animals are within the limits of the family.

Many new fossils have been discovered since Dépéret made the above statement, nevertheless it still remains true.

On page 295 of Volume III of the latest (1925) edition of von Zittel's *Textbook of Palæontology* we find the following words relating to mammals: "It is particularly surprising to find in Europe at least the origin of a new genus from a geologically older genus exceptional." At one time evolutionists were addicted to drawing up pedigrees, based on fossils, of living animals.

All of them have broken down before criticism, because they are not true pedigrees. Each was based on the assumption that if a fossil A is intermediate in certain respects between X and Y, fossils of a later date, A is an ancestor of X and Y. This assumption, needless to state, is not justified. As Bergson points out [*Creative Evolution* (1907)], it is possible, by making a suitable selection, to compose from living organisms a continuous series from amœba to man, each member of which is a little more complex, a little less amœba-like and a little more man-like than its predecessor. Such a series would not be genealogical, nor are the series of fossils on which pedigrees are based.

If one zoologist had a theory that human beings are gradually becoming taller but are decreasing in brain capacity, and another had a theory that men are becoming shorter but increasing in brain capacity, it would be quite easy for each of them, by having cemeteries rifled, to produce a chronological series of human skeletons, showing the increases and reductions he desired. Neither series would be phylogenetic.

The pedigree most paraded in popular books on evolution is that purporting to trace the descent of the horse of to-day from *Eohippus* of the Eocene through no fewer than seven genera. Even if this pedigree were a true one it would not prove that a new family had originated as the result of evolution, because the first member of the series—*Eohippus*—is a member of the horse family. Although it is not much larger than a fox, it exhibits four toes on the front foot and three on the hind, and its teeth are low-crowned, whereas those of the horse of to-day are high-crowned, *Eohippus* is as clearly a horse as the Pouter is a pigeon. Vialleton remarks (*Morphologie Générale*, p. 682):

> "*Eohippus* of the Lower Eocene and *Mesohippus* of the Oligocene, despite their feet having more than one toe, are easily recognizable, by their gracefulness, the length of their limbs, so different from those of other perissodactyls, as also by the form of the head and of the body, as representatives of the family *Equidæ*."

All that the large number of known fossils of the horse family tells us is: in the Eocene there lived at least three genera of horses (*Eohippus*, *Orohippus* and *Epihippus*), which were small animals with four toes in front and three behind, and possessed low-crowned teeth; in the Oligocene there lived at least two other genera (*Mesohippus* and *Miohippus*) of small horses having three toes on each foot and low-crowned teeth; in the Miocene there lived seven or more genera of large horses having three toes on each foot and long-crowned teeth; some of these lived on into the Pliocene, in which appear other genera having the side toes reduced to splints.

So far no fossils have been found connecting any of these with the horse of to-day. Some of them may be actual ancestors of the living *Equus*, but this has yet to be proved.

> "The supposed pedigree of the Equidæ," writes Dépéret (*loc. cit.*, p. 105), "is a deceitful delusion, which simply gives us the general process by which the tridactyl hoof of an ungulate can transform itself, in various groups, into a monodactyl hoof, in view of adaptation for speed, but it in no way enlightens us on the palæontological origin of the horse."

When more fossils are known it may be possible to construct a true pedigree of the various members of the horse family. We shall probably find that the family is composed of several genera, each of which begins as a pentadactyl or tetradactyl horse and suffers loss of the lateral toes as an adaptation to its environment.

What has been said applies *mutatis mutandis* to all the other long pedigrees that have been drawn up, such as those that purport to disclose the evolution of the bear, the elephant, the camel, the rhinoceros and the squirrel.

As the result of the severe handling of the pedigrees that have been drawn up, zoologists have become wary. Instead of drawing up definite pedigrees that can easily be demolished they now content themselves with making vague assertions, to attack which is to beat the thin air. Thus Professor W. D. Matthew writes of the Carnivora [*Encyclopædia Britannica* (1929), Vol. IV, p. 900]:

> "The ancestry of many of the modern genera can be traced back through the Pliocene, Miocene and Oligocene into or towards a common ancestral stock which appears to be fairly represented by the Eocene family *Miacidæ* of the Primitive Carnivora or Creodonta."

When we trace backwards the lines of descent of two closely allied living forms, these lines, instead of converging and meeting in a common ancestor, seem to follow a parallel course.

The most striking evidence in support of this assertion is furnished by the living members of the very ancient group of bivalve molluscs. Some of the families of this group can be traced back to the Silurian period by means of their fossils; no matter how far back we follow a genus it never merges into an allied genus.

In the family *Nuculidæ* the genus *Nucula* can be traced back as far as the Silurian and the genus *Acila* to the Cretaceous without blending. In the Cretaceous the two genera are as widely separated as they are to-day.

In the *Pinnidæ* family the genera *Pinna* and *Cyrtopinna* can be traced to the Jurassic and the genus *Atrina* to the Carboniferous without showing any sign of convergence.

In the family *Pectinidæ* the genera *Hinnites* and *Pecten* can be traced to the Triassic and *Amusium* to the Jurassic without meeting in a common ancestor.

It is not possible to draw up a pedigree showing the descent of any species, living or extinct, to an ancestor belonging to a different order or class.

The earliest-known fossils of each class and order are not half-made or half-developed forms, but exhibit, fully developed, all the characteristics of their class or order. Any changes undergone by a great group after it has appeared are comparatively insignificant.

It will be convenient to furnish proof of the above assertions by making a cursory survey of the geological record so far as it relates to the first appearance of each great group of animals and plants.

In the Ordovician appear suddenly:

The group of Protozoa known as the Foraminifera.

The three Echinoderm classes: Blastoidea, Echinoidea and Crinoidea.

The Ammonites.

The Nautiloidea.

Four orders of the Bryozoa.

The Ostracodes (water-fleas).

The Cirrhipedes.

No fossil has been discovered intermediate between any of the above groups and any other form. Palæontology seems to indicate that all the above have been separately created, because, if the evolution theory be true, every one of the scores of families that compose the above groups must be linked by a chain of forms to the particular family from which it evolved.

If such chains existed is it credible that not a fossil representing any of them should have been discovered?

In connection with the Blastoidea, it should be mentioned that fossils occur of a Blastoid genus, *Asteroblastus*, of which the breathing organs are diplopores, like those of some of the Cystoidea, whereas the breathing organs of the other Blastoids take the form of hydrospires.

Evolutionists regard this as evidence that the Blastoids evolved from the Cystids. This may have happened, but there is no reason why a Blastoid should not have been created with breathing organs resembling those of Cystids; two kinds of breathing organs occur in the latter. Moreover, if the primitive Blastoids breathed by diplopores, what caused them to exchange these for hydrospires? The supposed transformation seems improbable. Until fossils strictly intermediate between the Cystids and the Blastoids are discovered, we have no right to assume that the latter evolved from the former.

The sudden appearance of the Foraminifera in the Ordovician is most unfavourable to the doctrine of evolution, because, not only has no fossil been discovered ancestral to *Saccammina*, the earliest-known Foraminifer, but there is no known group of animals, extinct or living, from which it can have evolved. *Saccammina* is still living. It is globular in form, surrounded by a thick test or shell. Its shell is composed of but one chamber. Most Foraminifers are multi-chambered, each chamber of the shell communicating with those on either side of it. The chambers may be arranged in single or double linear series, or may form a spiral, in which case the shell has the form of that of the nautilus or an ammonite. In some forms the chambers are arranged irregularly.

Palæontology lends no support to the theory that the multi-chambered forms evolved from a single-chambered ancestor. The majority of families include one- and many-chambered forms. New families that contain both uni- and multi-locular forms appear comparatively late in the history of the earth; for example, the *Globigerinidæ*. This family is not known before the Trias, in which it is represented by the unilocular *Orbulina* and the multilocular *Globigerina*. No form is known from which either of these genera can have evolved.

In the Silurian the following groups make their appearance: the Brittle star-fish (*Ophiuroidea*), two new orders of *Echinoidea*, the Scorpions and two class of vertebrates—the *Ostracodermi* and the *Selachii* or *Elasmobranchii*.

Not a single fossil has been discovered intermediate between any of these and another organism.

The sudden appearance of the vertebrates in the form of four orders is most unfavourable to the doctrine of evolution.

The Ostracodermi, which lack jaws and paired fins, are represented in the Silurian by three orders. Restorations of some of their fossils are exhibited at the Natural History Museum, South Kensington.

In the *Anaspida*, represented by the fossils *Birkenia* and *Lasanius*, found in the Downtonian formation of Scotland, the body is shaped like that of an ordinary fish, but there is only one fin; this projects from the back. The head is covered with hard tubercules, and the rest of the body with scales arranged in rows. A line of curved spines runs along the abdomen.

In the *Heterostraci*, represented in the Silurian by the fossils *Thelodus*, *Lanarkia* and *Cyathaspis*, the head, unlike that of the *Anaspida*, is broad and the eyes are set far apart in the sides of the head. The skin is covered by tubercules which may be spine-like or flattened.

In the *Osteostraci*, of which several genera occur in the Silurian, the eyes are close together on top of the head, and the skin tubercules are united into plates of bone. According to the evolutionist, bone is not formed until an advanced stage of vertebrate evolution; in the living lampreys and hag-fish the skeleton is entirely cartilaginous. The Osteostraci differ from the other two Ostracoderm orders in possessing a pair of flippers just behind the head.

The fourth order of Silurian vertebrates, the *Acanthodii*, belongs to the class *Elasmobranchii*. This class differs fundamentally from the Ostracodermi. Its members are shark-like; they are completely armoured with hard scales. The openings of the gill slits are separate and exposed. Elasmobranchs, unlike Ostrocoderms, possess regular jaws and paired fins. Each fin is armed in front by a spine. All the above vertebrates possessed eyes—organs not seen in any earlier fossils.

None of the above groups bears the least resemblance to any invertebrate class or phylum. Evolutionists can only make guesses as to their ancestry.

If the evolution theory be true, all these Silurian vertebrates evolved gradually from some unknown ancestor, which must have lived many millions of years previous to the earliest-known vertebrate fossils. This hypothetical ancestor must have given rise to two main lines of descendants, one line evolving into the Ostracoderms and the other into the Selachians. After the first Ostracoderm had evolved it must have given off three lines of descendants, resulting in the evolution of the three Ostracoderm orders that occur in the Silurian. Thus a long line, representing hundreds of successive species, must have connected each group of Silurian vertebrates with a common ancestor. As all, or, at any rate, all the later members of each line, must have had hard parts and so be readily fossilized, is it credible that, if such creatures existed, not a single fossil or other trace of them should have been discovered?

Those who believe in creation or abrupt origin could hardly demand stronger evidence in support of their doctrine than that afforded by the earliest-known vertebrate fossils.

In the Devonian the *Pisces* (true fish) make their *début*. They show themselves in considerable diversity, the fossils of this period representing two of the three sub-classes of which the Pisces are composed—the *Palæopterygii* and the *Crossopterygii*. The fossils of the latter belong to two of the three orders that compose it—the *Rhipidistia* and the *Dipneusti*.

If, then, the evolution doctrine be true, the first fish must have evolved a very long time before the earliest-known fossils of the class appear. This primitive fish must have given rise to two diverging lines of descendants, one of which evolved into the Palæopterygii and the other into the Crossopterygii. After the latter had arisen some member must have given off two lines of descendants, one of which developed into the Dipneusti and the other into the Rhipidistia.

If such a host of intermediate forms and their collaterals existed, is it likely that no traces of any of them should have been discovered in the rocks?

In the Carboniferous the first animals capable existing on land appear.

The groups that make their *début* in this period are:

Three of the six orders that compose the class Amphibia.

The spiders.

No fewer than twelve orders of the class Insecta.

Two orders of the class Reptilia.

The abrupt appearance of terrestrial organisms in such variety and number is not easy to reconcile with the evolution theory.

To the evolutionist the Carboniferous is a period of wonders. In it two sets of aquatic invertebrates discovered how to exist out of water and one of them acquired wings and then blossomed out into twelve orders, some fish converted themselves into amphibia, and, scarcely had this been accomplished, when a newly-formed amphibian performed the great feat (see p. 68) of transforming itself into a terrestrial reptile.

No fossils have been found intermediate between spiders and insects and any other group. The earliest undoubted remains of insects occur in the Lower Carboniferous, both in Europe and N. America. In the Upper Carboniferous twelve orders of insects are known to have existed, all of which have become extinct except the *Blattoidea*, to which the cockroaches belong.

It is difficult to understand how an aquatic creature could gradually acquire tracheæ (air-breathing organs) (see p. 88) and legs. It might be thought that the acquisition of these would have taxed the powers of an organism to the uttermost. Far from it, primitive insects were not content with being able to run, they must needs fly. As all the earliest fossils known to us possessed wings, these must have grown before the insects split up into orders. The gradual conversion of aquatic organisms into insects representing twelve orders must have occupied many millions of years. If it took place, is it credible that no fossil should have been found of a species intermediate between this hypothetical father of all insects and any of the twelve orders that occur in the Carboniferous, or between it and its aquatic ancestor?

Attempts have been made to minimize the great diversity of the Carboniferous insects. Thus, on page

794 of the first volume of von Zittel's *Textbook of Palæontology* (1913) it is written:

> "Although it is clear that strangely differentiated forms occurred among the different insect groups as early as the Carboniferous, yet it has been conclusively shown that this differentiation had little depth, and that it is only through Mesozoic and later descendants that we have any clue to a wide separation of the original Palæozoic forms. The forewings of whatever type were as diaphanous as the hind and could never (as in most of their descendants) properly be called *tegmina*."

The Carboniferous insects were certainly less differentiated than those now existing; wingless orders apparently did not then exist, and the known fossils represent twelve orders, while the living insects represent thirty-one, but it is absurd to assert that a differentiation that requires these creatures to be grouped in twelve orders has little depth. A few of these early insects were of greater size than any living ones. In some the wings could not be folded back, in others they could. In some the legs were adapted for jumping like those of locusts. In one genus the first pair of legs was furnished with a spinning apparatus, indicating that their possessors had habits similar to those of spiders.

Spiders, like insects, display great diversity on their first appearance. The Carboniferous fossils represent not only most living orders but three extinct orders. These early spiders are fully-formed and exhibit spinnerets similar to those of modern forms. As in the case of insects, no fossils have been discovered linking the early spiders with any other group or species. Presumably they preyed upon insects; therefore, if the evolution doctrine be true, they should not have originated until after the insects had become well established.

Nevertheless, the fossils indicate the simultaneous appearance of the spiders and their insect quarry.

The earliest-known amphibian fossils occur in the Lower Carboniferous; they belong to the order *Labyrinthodontia.* In the Upper Carboniferous appear suddenly two more orders: the *Lepospondylia* or *Aistopoda* and the *Phyllospondylia* or *Microsauria.*

These differ profoundly from any of the other three orders of amphibia; they are sometimes grouped together as a super-order known as the *Stegocephalia*, because in all the head was protected by external bony plates, sculptured on the outer surface and intersected by symmetrically-placed grooves, called mucous or slime canals. Some of these forms attained dimensions far exceeding those of any recent amphibian; *Mastodonsaurus giganteus* possessed a head four feet long. Their range was almost world-wide.

The Labyrinthodontia are distinguished from the other two orders, *inter alia*, by the peculiar labyrinthine pattern exhibited by transverse sections of their teeth and by the fact that the skull articulated with the first vertebra by means of a single condyle. The Phyllospondylia had well-developed limbs and were lizard-like in shape; the Lepospondylia lacked limbs.

No fossils are known representing ancestors of any of these three orders, but the skull of certain Carboniferous fish—the Osteolepids—bears some resemblance to that of the *Embolomeri*—a sub-order of the Labyrinthodontia. From this evolutionists conclude that the Embolomeri evolved from some fish unknown to us but closely allied to the Osteolepids.

On page 853 of the first volume of the *Encyclopædia Britannica* (1929) Dr. G. K. Noble gives drawings of the skulls of the two forms and details the points of resemblance. He candidly admits that there are considerable differences between the two skulls, which "would seem to exclude the osteolepids from immediate ancestorship" to the amphibia, but he regards the former as collaterals of ancestors.

The similarity, be it remarked, is confined to the skull, and even so, the teeth are very different; moreover, in one there is a stapes (one of the ear bones), in the other this is lacking; in one the head is provided with external armour, in the other it is not.

Similarity of an organ in two animals does not necessarily indicate that they are closely related. We have noticed that very dissimilar forms possess tracheæ and identical nephridia. The hind limb and tail of the Dinosaur—*Iguanodon*—resemble those of the kangaroo; in the primate *Tarsius* and the marsupial *Dromicia* the second and third toes have curious and almost identical claws that are used as a toilet comb. No one believes that these features denote kinship. Moreover, the osteolepids possess fins, while the Embolomeri have ambulatory limbs.

These organs differ so greatly in anatomy and function that I find it impossible to believe that one evolved gradually from the other.

The limbs of every amphibian and terrestrial vertebrate invariably bend at the elbow and wrist or knee and ankle, as the case may be. There is no known fish in which the fin is jointed in this way. The fossil fish of which the pectoral fin is least unlike an ambulatory limb is the Crossopterygian *Sauripterus taylori.* A sketch (Fig. 6) of this fin is here reproduced (after Adams and Gregory), together with one of a typical ambulatory limb (Fig. 7). These show the amount of change that must have taken place in order to convert a fin into a leg. The limbs of the earliest-known amphibia are no more like those of fish than are those of living amphibia. Some of them have five toes, others three. The earliest-known amphibian fossil, *Thinopus antiquus*, of the Lower Carboniferous has but three. According to the evolution theory it ought to have five.

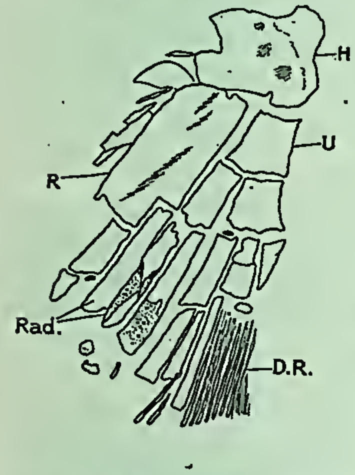

FIG. 6.—Fossil of Right Pectoral Fin of *Sauripterus taylori*. (After Adams and Gregory.)

H, Humerus; *R*, Radius; *U*, Ulna; *Rad.*, Radials; *D.R.*, Dermal Rays.

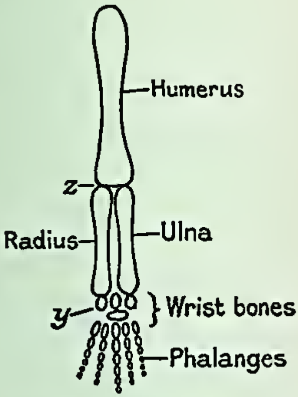

FIG. 7.—Diagram of the Limb of a Tetrapod. This is jointed at *z* and *y*.

If, for the sake of argument, it be admitted that the Osteolepids and the Embolomeri are related, evolutionists still have to account for the appearance of the Lepospondylia and Phylospondylia hard upon that of the Embolomeri. These appear simultaneously and no fossil is known linking them to any other group. Moreover, no fossils have been found that throw any light on the supposed evolution of the other three orders of Amphibia which appear much later. These facts, coupled with the mechanical and physiological difficulties that have to be overcome before a fish can be gradually transformed into an amphibian, are in favour of the view that the resemblance between the skulls of the Osteolepids and Embolomeri is not a sign of kinship. So varied are the forms of life that such resemblances are to be expected.

The earliest fossils that are undoubtedly reptilian occur in the Upper Carboniferous. This is so soon after the appearance of the first amphibians as to render improbable the theory that the former evolved gradually from the latter. The Carboniferous fossils believed by most palæontologists to be those of reptiles display great diversity; in consequence they are grouped in two orders —the *Seymouriamorpha* and the *Pelycosauria.* There is nothing very striking in the appearance of the seymouriamorphs, but the pelycosaurs were weird-looking creatures. Two of them—*Dimetrodon* and *Naosaurus*—must have had, to quote Professor D. M. S. Watson, a "grotesque appearance, one with a huge head and great piercing teeth, the other with a small head and crushing dentition, each with a crest as high as its own length from the head to the root of the tail." This crest is supported by spines, nearly two feet long, projecting from the vertebræ. In some pelycosaurs the spines exhibit a series of transverse processes like the yard-arms of a ship's mast. The skull of the pelycosaurs is double-roofed, that of the seymouriamorphs is not. The shoulder girdles are quite different in the two orders. If these orders are both reptilian, the first reptile to evolve must have lived millions of years before the earliest-known fossils of reptiles, and fossils linking each of the Carboniferous orders with this ancestor ought to have been found. No fossil is known connecting the grotesque pelycosaurs with any other group. The Seymouriamorpha, on the other hand, present certain resemblances to the Labyrinthodonts. One of them, *Seymouria* from the lowest Permian, of which the anatomy is fully known, is described in some detail by Watson in his article on Reptiles in Volume XIX of the *Encyclopædia Britannica* (1929). He is of opinion that this fossil constitutes a veritable link between the Stegocephali and the reptiles. He points out that zoologists are divided in opinion as to whether it is a reptile or an amphibian. He deems it the former.

The Labyrinthodont features of *Seymouria* are:

1. The pattern of the bones of the roof of the skull is identical with that of the earlier Labyrinthodonts.
2. The palate is similar.
3. The lower jaw is similar.
4. The ribs are like those of some Labyrinthodonts.
5. The limb girdles and limbs exhibit amphibian features.

Its reptilian characters are:

1. The brain.
2. The single occipital condyle (the projection from the skull that articulates with the first vertebra).
3. The structure of the first vertebra.
4. The presence of a *fenestra ovalis* leading to the ear.

It would be reasonable to regard *Seymouria* as a link between the reptiles and amphibia but for the fact that the pelycosaurs are contemporaries of the seymouriamorphs. These two orders are so unlike that one cannot have arisen from the other, and it is difficult to believe that they evolved from a common ancestor.

What the doctrine of evolution requires is fossils linking the pelycosaurs with the labyrinthodonts. In default of these it seems reasonable to regard the seymouriamorphs as labyrinthodonts of which some of the organs bear a resemblance to those of reptiles. In view of the great diversity of animal life it would be surprising if such resemblances did not occur. Some living amphibians, such as *Amblystoma* and the newts, are not unlike lizards in form.

It is significant in this case, as in that of the osteolepid fish, that, when a fossil is found which seems to testify in favour of the doctrine of evolution, other fossils occur in the same period that seem to nullify this testimony. Nature, so to speak, takes away with one hand that which has been given with the other.

In the Permian appear six new orders of reptiles and a sub-class of Pisces—the *Neopterygii*. No fossils are known connecting the latter with any other group of fish. Evolutionists believe the Neopterygii to have evolved from the Palæopterygian family, *Palæonischidæ*, this being the only known family from which they can possibly have arisen by a process of gradual change.

The six new orders of reptiles that made their appearance in the Permian were short-lived, none outlasted the Triassic period. There is nothing very remarkable about the skeletons of any of them, but one order—the *Theriodontia*—is of interest because evolutionists believe that it gave birth to the mammals. No fossils are known intermediate between any of these six orders of Permian reptiles and either the Seymouriamorpha or the Pelycosauria. In the Trias appear the first mammals and five remarkable orders of aquatic reptiles—the *Nothosauria*, *Ichthyosauria*, *Plesiosauria*, *Thalattosauria*, and *Chelonia*. In the first three the limbs are broad and served as paddles. In the *Nothosauria* the limb-bones are comparatively well developed, the elbow and wrist joints are flexible and the digits exhibit the same number of bones as those of land reptiles. In the *Plesiosauria* the limb-bones are so shortened as to have much the same shape as those of the wrist and ankle, there is no flexible joint at the elbow or knee, in consequence each limb forms a rigid paddle, the bones of the digits·exceed in number those of terrestrial reptiles. The tail must have acted as a fin-like propeller. In most of the Plesiosaurs the neck is very long; in some species it is ten times the length of the head. The Ichthyosaurs are even more fish- or porpoise-like than the Plesiosaurs. In them the tail is very long, the spine being bent down at some distance from the tip to support a ventral tail fin. There is also a fin on the back, stiffened by bone. The snout is long and attenuated. The limbs are as rigid as and broader than those of the plesiosaurs, the bones of the wrist and digits are pressed together to form a mosaic composed of a large number of bones. Some of the later Ichthyosaurs attain a length of forty feet. These creatures, instead of laying eggs on land as most reptiles do, seem to have brought forth their young alive in the water; a fossil has been found with six embryos within the ribs. The range of the plesiosaurs and ichthyosaurs was cosmopolitan, and many of their fossils have been found.

It has been suggested that the nothosaurs are intermediate between the plesiosaurs and ordinary land reptiles. The limb-bones of the former certainly are more like those of ordinary reptiles, but this is equally true of those of the plesiosaurs in comparison with those of ichthyosaurs, but no one suggests that this is because the plesiosaurs are intermediate between ichthyosaurs and land forms. The nothosaurs and ichthyosaurs appear almost simultaneously in the Middle Trias, while the plesiosaurs are not known before the Upper Trias. No fossil known to us throws light on the origin of any of them. This is exceedingly unfavourable to the doctrine of evolution in the case of the ichthyosaurs, because in structure they are very widely separated from all other reptiles; moreover, large numbers of their fossils are known.

> "It may now truthfully be said," writes Professor S. W. Williston (*Water Reptiles of the Past and Present*, p. 112), "that of no group of extinct reptiles do we have a more complete and satisfactory knowledge than of the ichthyosaurs. Nevertheless we have yet very much more to learn about the order Ichthyosauria as a whole—whence they came and how they originated; what their nearest kin were among reptiles; and, especially more about the connecting links between them and terrestrial reptiles. They have as an order, so isolated a position, and are so widely separated from all other reptiles in structure, that they have long been a puzzle to Palæontologists. Like the whales and other cetaceans among mammals, we know the ichthyosaurs well in the plenitude of their power and the fullness of their development, but have yet only an imperfect knowledge of their earlier history, and none whatever of their earliest."

Not much is known of the *Thalattosauria*. The bones of the forearm are flattened, the head is long and the nostrils are on top of it, as in the crocodile, but placed immediately in front of the eyes. The Thalattosauria appear in the Upper Trias. No fossils are known that link them with any other reptiles.

The *Chelonia* (the order to which the turtles and tortoises belong), which appear in the Middle Trias, are as widely separated from other reptiles as are the ichthyosaurs; no fossils are known connecting them with any other form. They may be described as animals that live in boxes. The body is encased in a shell, composed of dermal bones, attached to the vertebræ and the ribs, provided with apertures through which head and limbs can protrude. The limb girdles are unique in that they lie entirely within the ribs. The openings through which the fore legs project are placed so far forward that the humerus (upper-arm bone) has to be twisted to allow the protrusion of the limb. That the legs of an ordinary reptile could gradually have become twisted in this manner seems highly improbable. Palæontology does not require us to believe that this took place gradually, because the earliest known Chelonian fossils exhibit all the characteristics of the group, including the ventral plastron, dorsal shield and curiously placed and shaped limbs. Nor are any fossils known linking these with any other reptile. Of them Williston writes (*loc. cit.*, p. 216):

> "No order of reptiles of the past or present is more sharply and unequivocally distinguished from all others than the *Chelonia* or *Testudinata*. No order has had a more uniformly continuous and uneventful history, and of none is the origin more obscure. The first-known members of the order, in Triassic times, were turtles in all . . . respects. . . . Relationship with other reptiles they really have none."

The absence of fossils intermediate between the *Chelonia* and ordinary reptiles is evidence against the doctrine of evolution as strong as negative evidence can be, because, again to quote Williston, "the remains of no other air-breathing vertebrates are so omnipresent in the rocks as those of turtles." Is it credible that, while fossils of the fully-formed Chelonia occur in abundance, not a single fossil is known of any one of a very long line of ancestors that must have existed if the evolution doctrine be true?

Hardly less remarkable than the above aquatic forms were the Dinosaurs which also appear in the Trias. These are now usually deemed to be composed of two orders—the *Saurischia* and the *Ornithischia*. These reptiles had long hind and short front legs, so that they were bipedal. They varied in size from that of the rabbit to that of a giraffe. No fossils are known linking either group of Dinosaur with any other group.

The earliest-known fossils which are generally believed to be those of mammals occur in the Upper Trias of Europe, S. Africa and N. America. Unfortunately all these fossils are very fragmentary; one consists of the greater part of a skull, two of lower jaws and the rest of isolated teeth. Such remains are insufficient to enable systematists to classify with certainty the animals to which they belong; in consequence there is diversity of opinion among palæontologists as to the nature of these fossils. At one time it was thought that all were mammals; latterly doubts have been raised on this point. If they be mammalian, they belong to sub-classes very unlike any now living. These and other early mammalian fossils are discussed in Appendix III.

Here it will suffice to remark that evolutionists believe that mammals evolved from the *Cynodontia*—a sub-order of the reptilian Order *Theriodontia*, that lived in the Lower Permian and Upper Triassic periods; their skull resembles that of carnivorous mammals in several respects. Among other features they possess canine teeth. Such resemblances, however, do not necessarily imply relationship. The most that can safely be said in the present state of our knowledge is, if mammals evolved gradually from reptiles, the Cynodonts seem the group most likely to have given birth to them.

Another group that makes its appearance in the Trias is that of the Dibranchiate Molluscs (cuttle-fish and squids). This shows itself in the form of the extinct Belemnites. No known fossils shed any light on the origin of these forms.

In the Jura appear:

The crabs and lobsters.

Two orders of Amphibians, viz. the *Caudata* or *Urodela* (salamanders, newts, etc.) and the *Anura*, *Ecaudata* or *Salientia* (frogs and toads).

The Pterosaurs.

The *Mososauria* or *Pleurosauria*.

The lizards.

Birds.

Three orders of supposed Mammals—the *Triconodonta*, *Pantotheria* and *Symmetrodonta*.

No fossils have been discovered throwing light on the origin of any of the above groups.

As regards the amphibians, the three early orders seem to have become extinct before the end of the Trias, while the Caudata and Anura do not appear until the Upper Jura. A hiatus of such extent is an unusual phenomenon.

No fossils are known intermediate between either of these modern groups and any earlier amphibian. The earliest-known Urodela and Anura do not differ greatly from living forms. Some of the extinct species, however, were far bigger than any living ones. The salamander *Cryptobranchus* of the Miocene was over five feet in length. The pterosaurs, or pterodactyls, are perhaps the most remarkable of all reptiles. In their time they filled the same place in nature as birds now do. Of their peculiarities mention may be made of the following:

1. The outermost finger, which served to support the great wing membrane, is very long. The other fingers are small.

2. Many of the bones are hollow and filled with air, like those of birds.

3. The skull is unlike that of any other known reptile and in some respects resembles that of a bird.

4. The head, like that of a bird, is carried at right angles to the neck.

5. The breast-bone, like that of most birds, exhibits a keel for the insertion of the powerful motor muscles of the wing.

6. The brain seems to have resembled that of a bird.

All the above avian features seem to be connected with the power of flight possessed by these reptiles, and to have nothing to do with blood relationship. Few believe that birds evolved from pterodactyls. Profound differences in the anatomy of the two groups seem to forbid this.

The pterosaurs are divided into two sub-orders—the *Rhamphorhynchoidæ*, which appear in the Lower and disappear in the Upper Jura, and the *Pterodactyloidæ*, which first occur in the Upper Jura and persist until the Upper Cretaceous. In the former group the tail is short and the fifth toe well developed; in the latter the tail is long and the fifth toe small or lacking.

Apart from the fact that the earlier forms were small and some of the later ones large, the pterosaurs seem to have undergone very little change during the not inconsiderable period of their existence. Some of the earlier forms are no bigger than a sparrow, while *Pteranodon occidentalis* from the Upper Cretaceous has a wing expanse of eighteen feet. As the gradual evolution of so peculiar a form as a pterosaur from an ordinary reptile must have occupied a long period, the complete absence of intermediate fossils constitutes weighty evidence against the evolution theory.

The *Mososauria*, which some regard as a sub-order of the *Squamata*—the group to which lizards and snakes belong,—were greatly elongated aquatic reptiles. Some attained a length of fifty feet. The limbs constitute paddles, the leg bones being short and the digits long and flattened. The skull is lizard-like, but the lower jaw, like that of a snake, is attached to the skull in such a manner that it can open very wide and so take in bulky quarry.

From the foregoing it is apparent that among the ancient reptiles were a number of aquatic groups of peculiar form. If the evolution theory be true, the reptiles were the first vertebrates to adapt themselves to a fully terrestrial existence. Does it not seem strange that, having accomplished this great feat, half a dozen orders should have returned to the liquid element? The evolutionist must suppose this unless a reptile has evolved several times from an amphibian or fish.

From the Upper Jurassic deposits of Bavaria two very remarkable fossils have been unearthed—the earliest birds known to us. These fossils resemble one another closely. They are named *Archæopteryx* and *Archæornis.* The former is exhibited in the Natural History Museum at South Kensington and the latter in the Berlin Museum. They differ in structure from any other known bird, living or extinct. The long tail is supported by about twenty vertebræ, each of which bears a pair of feathers. The neck vertebræ are fewer in number than those of any other known bird. Each mandible exhibits thirteen teeth implanted in sockets. *Archæornis* has abdominal ribs and the constituent bones of the hip are separate. The metacarpals (bones in the wing), unlike those of living birds, are not fused, and each digit is furnished with a claw projecting beyond the wing. Possibly the wings were used both as flying and climbing organs. Apart from these features the fossils might be those of some living species of bird. *The feathers of the wing* *and tail are as perfectly developed as those of any modern bird and the legs and feet are very like those of a crow.*

The characters adduced as evidence of the relationship of these birds to reptiles—the large number of movable vertebræ in the tail and the teeth—are features that may vary in closely allied forms; thus, some monkeys are tailless while others have long prehensile tails; some whales have teeth, others are toothless. These features, then, count for little against the possession of feathers—essentially avian structures. Nevertheless, Heilmann writes [*The Origin of Birds* (1926), p. 36]: "We may now stop talking about 'the missing link' between birds and reptiles. So much so is *Archæornis* this that we may term it a warm-blooded reptile disguised as a bird."

The first part of the above assertion is justified, but not the second. The expression "missing link," which has become a popular catchword, is misleading because it implies the existence of a chain composed of a series of fossils connecting two groups of animals. *No such chain joining up any two of the larger groups of organisms is known.* At the most we have a few disconnected rings, each of which evolutionists assert to be part of a chain —a different chain in each case. *In order to prove their theory evolutionists have to find, not a few missing links, but scores of whole lengths of chain.* That these Jurassic fossils are not links between reptiles and birds is evident from the fact that they do not even suggest the order of reptiles from which birds evolved. There is no agreement among evolutionists as to the group of reptiles that gave birth to the birds. At least three reptilian orders have been named in this connection. Nor is this all; no fossil exists intermediate between these Jurassic birds and any other order of the *Aves*.

The Jurassic fossils believed to be mammalian consist mostly of isolated bones, teeth and parts of skulls. They belong to none of the living sub-classes of mammals, and no fossils have been found linking them with the Triassic forms. One of these Jurassic fossils, however, is deemed by evolutionists to be a cousin of an ancestor of all living mammals except the monotremes. This is *Amphitherium* of the Order *Pantotheria* or *Trituberculata*. The only part of this creature that has yet been discovered is a jaw containing some of the teeth. It is asserted that a jaw of this kind could, without much modification, be converted into that of a marsupial or pouched mammal and into that of a placental. These supposed early mammalian fossils are considered in some detail in Appendix III.

Here it will suffice to say that the four orders supposed to be mammals, of which fossils have been found, form three groups that differ so profoundly from one another that it does not seem possible that any one can have been derived from any other, or that the monotremes (egg-laying mammals) can have arisen from any of them. Thus, some evolutionists believe that on no fewer than four independent occasions a reptile has been converted into a mammal!

The latest pedigree of the mammals, that drawn up by Simpson, is reproduced on page 180.

In the Cretaceous appear three new orders of birds and the first marsupial and placental mammals.

No fossils have been found intermediate between any of these and earlier forms.

All the Cretaceous birds exhibit teeth structures not found in any living bird. In some cases the teeth are implanted in separate sockets, in others in a common groove. This is not easy to account for on the view that all birds are derived from a common ancestor.

One order of the Cretaceous birds—The *Hesperornithiformes*—seems to have lacked the power of flight. As this group occurs later than *Archæopteryx*, which could fly, if the doctrine of evolution be true, it would seem that some birds lost the power of flight soon after they had acquired it.

The marsupial fossils of the Cretaceous belong to the order *Didelphiidæ*, of which the living Opossums are members.

The placental mammals appear almost simultaneously in N. Asia and N. America. These early forms belong to the order *Insectivora*, of which the shrews, moles and hedgehogs are familiar examples.

In the earliest layer of the Eocene (Palæocene) appear suddenly four new orders of placental mammals—the *Creodonta*, *Condylarthra*, *Amblypoda* and *Tæniodonta*—all of which became extinct long ago. No fossils are known intermediate between any of them and any earlier form.

The Creodonts were carnivorous, as were probably the Condylarths, although their toes terminated in hoofs. The Amblypods were hoofed animals of heavy build; some had sabre-like upper tusks and several horns on top of the head; a few of them were bigger than the rhinoceros.

The Tæniodonta, or Ganodonta, were heavily-built sloth-like creatures.

Even more surprising to the evolutionist than the apparition of the above groups of mammals must be the great array of new mammals that appear suddenly in the Eocene: Carnivores (Fissipedes), Odd-toed Ungulates, Even-toed Ungulates, *Hyracoidea*, Edentates, Rodents, *Proboscidea*, *Cetacea* (Zeuglodontidæ and Toothed Whales), Sea-cows, Primates, Pangolins, Aard-varks and the following orders that have since become extinct:

Litopterna, *Typotheria*, *Entelonychia*, *Astrapotherioidea*, *Palæonodontia*, *Toxodontia*, *Pyrotheria* and *Embrithopoda*.

Considerations of space render it impracticable to describe all these extinct orders; it must suffice that they were represented by animals ranging between the rabbit and rhinoceros in size. It is significant that this great array of placental mammals appears on the scene practically simultaneously, as time is reckoned geologically. Moreover, it is not possible to point to any fossil as an ancestor of any of the above groups.

The *Chiroptera* (bats) have not been included in the above list, as it is not certain whether the deposits in which the earliest-known fossils of this order occur are of the Upper Eocene or Lower Oligocene epoch. In either case the bats appear, fully formed, very shortly after the other groups mentioned above. Bats, being the only mammals that can fly, differ profoundly from all others in skeletal structure. It is scarcely necessary to state that the so-called flying squirrels and lemurs cannot fly, nor have they wings. A fur-covered membrane connecting the fore and hind limbs enables them to glide through the air. The structure of this parachute is altogether different from that of the wing of a bat. If bats gradually evolved from an ordinary mammal, the transitional forms cannot possibly have resembled flying squirrels or lemurs.

The following are a few of the structural peculiarities of bats: the shoulder-blades and fore limbs are twisted outwards 90 degrees; the upper arm bone is bent into a very elongated S; the bones of the lower arm are much lengthened and curved; the hind limb is twisted outwards 180 degrees, so that the toes point backwards; the fingers are nearly as long as the arm.

The hip bones and hind limbs are greatly developed in birds, in consequence these can walk and maintain themselves upright on a perch; in bats the hip bones are small and the hind limbs weak; therefore bats can neither walk well nor maintain an upright position on a perch. When resting or sleeping they hang head downwards, the hind limbs serving as hooks. The wing is a great expanse of skin stretched over the fingers and from thence to the hind limbs and tail.

No fossil has been discovered intermediate between a bat and any other animal, despite the high degree of specialization of the former and the fact that they make their appearance at the close of the Eocene—an epoch peculiarly rich in mammalian fossils.

We have noticed that the earliest-known fossils of Primates occur in the Eocene. These belong to two groups—the Tarsioids and the Lemuroids Two more Primate groups—the New and the Old World Monkeys—appear in the Oligocene. No fossils are known intermediate between the New World monkeys and any other group, but a fragment of a lower jaw—the fossil known as *Apidium*—has been found in the Lower Oligocene, the teeth of which, in the opinion of some, *may be* transitional between those of early primates and the Old World monkeys.

In the Miocene the following groups make their appearance:

The aquatic carnivores (*Pinnipedia*).

The whalebone whales (*Mystacoceti*).

The anthropoid apes.

The Pinnipedia are composed of three families: the sea-lions, seals and walruses. These appear simultaneously. Despite their recent appearance no fossil is known that sheds any light on their origin.

This is equally true of the whalebone whales.

Evolutionists point to two fossils which they consider throw light on the origin of anthropoid apes. One is a jaw, named *Propliopithecus haeckeli*, from the Lower Oligocene of Egypt; this, although small, like that of an ordinary monkey, is deep and the cusps of its molar teeth are arranged substantially as in the anthropoids. The other—*Oreopithecus* of the Miocene—is a large jaw of which the molar teeth "suggest remote relationship with the anthropoid apes." At the utmost these two fossils merely indicate the origin by evolution of a new family; the groups which they are supposed to link belong to the same order.

The latest groups to appear are the Monotremes and Man. Fossils of these are not known earlier than the Pleistocene.

The monotremes are to-day represented by the living duck-billed platypus (*Ornithorhynchus*) and the spiny ant-eater (*Echidna*). As these are far more lowly animals than the marsupials, their appearance long after these is not in accordance with the doctrine of evolution. The evolutionist explains this fact by asserting that the monotremes evolved from an unknown ancestor in an unknown part of the world, and, after they had fully evolved, migrated to Australasia.

As regards man, there is no known fossil to which one can point and say positively, "That fossil, while not man, is one of his direct ancestors." The fossils that have been adduced as links connecting him with other animals are considered in Appendix IV.

The foregoing facts demonstrate that no fossil is known that can be cited as a direct ancestor of any class, sub-class or order of animals.

This is equally true of plants. *Propliopithecus*, mentioned above, if it be ancestral to the anthropoid apes, is merely the ancestor of a family and is proof that a new family can arise by evolution.

One fossil has been cited—*Amphitherium*—which evolutionists suppose to be a collateral of an ancestor of the higher mammals; another, *Osteolepis*, it is asserted, is a collateral of a piscine ancestor of the amphibia. The Echinoderm, *Asteroblastus*, combines some of the characteristics of both Blastoids and Cystids. *Seymouria* exhibits both amphibian and reptilian features and the cynodont reptiles have skulls and teeth that bear some resemblance to those of mammals.

As has already been pointed out, the existence of the above organisms and groups is not incompatible with the theory that every class and order is a separate creation, or originated abruptly.

The above evidence falls far short of proving the hypothesis that each class and order evolved gradually from some pre-existing group. There is no denying the fact that the fossils discovered since Darwin's time have not been in accordance with the expectations of evolutionists, which were that there would be found fossils of incipient whales, incipient bats, incipient turtles and the like.

> "It is very strange," writes Cuénot [*L'Adaptation* (1925)], " . . . that on every occasion when a new fossil is discovered that does not belong to any of the known groups and is anterior to them, it is placed in the immediate vicinity of the animals to which it approaches most nearly, not on the same stem, but as a little lateral branch. . . . It is singular that the main stem and the petioles (of the genealogical tree) are always without representatives, that the missing link remains always a missing link."

It is most significant that *no fossil has been discovered that represents a half-formed type of animal.* The earliest-known insects are complete insects, the earliest scorpions are fully formed, as are the earliest spiders, crabs, snakes, turtles, pterodactyls, ichthyosaurs, frogs, cetaceans, sea-cows, seals, bats, etc.

It is submitted that the fact that not a single fossil is known intermediate between any of the creatures endowed with the power of flight and an ordinary animal is sufficient to refute the evolution theory.

According to the evolutionist wings evolved independently on four occasions, i.e. in insects, pterodactyls, birds and bats.

Although organisms in which the powers of flight are fully developed are not so liable as ordinary animals to become fossilized (on occasions when the latter are buried by landslides or drowned by floods, winged creatures can fly to a place of safety), an animal in the process of acquiring the power of flight is peculiarly liable to meet with fatal accidents. Human experience in aviation demonstrates this. The acquisition of wings by the accumulation of variations or mutations must in each case have taken many thousands of years. For a considerable part of this period the casualties as the result of accidents among the animals so evolving must have been exceedingly numerous. In consequence the deposits laid down during the periods in question should contain many fossils of these incipient flying animals: the Devonian should hold thousands of fossils of what may be termed pro-insects, the Trias a multitude of those of pro-pterosaurs, the Trias and Lower Jura a great many of those of pro-Aves, and the Eocene a large number of those of pro-Chiroptera. It is submitted that these pro-creatures exist only in the imagination of evolutionists.

The fact that every new group of animals appears suddenly and, usually, in considerable variety is not the only part of the testimony of the fossils unfavourable to the doctrine of evolution.

The fossils indicate that the various groups of animals undergo comparatively little change after they have made their appearance.

In support of this the following may be quoted from von Zittel's *Textbook of Palæontology*, Vol. I (1913), p. 15):

> "As observation shows, not only do most plants and animals now living in a wild state adhere to their peculiar characteristics with great tenacity, exhibiting barely appreciable changes even in the course of hundreds or thousands of years, but, furthermore, fossil species remain within the limits of a single geological period fairly constant. With the beginning of a new epoch or period, however, which is usually indicated in the section by lithologic changes, a greater or less number of species either entirely disappears, or is replaced by closely related, but at the same time more or less different forms. Obviously, therefore, there have been periods when the process of transformation and the weeding out of organisms were greatly accelerated, and, following upon these reconstructive periods, long intervals of repose have ensued, during which intervals species have retained their characteristic forms with but little variation."

In the foregoing no mention has been made of plants. Considerations of space render it impracticable to survey their fossils. It must suffice that these afford no more support to the doctrine of evolution than do the animal fossils. They show that the simplest plants, the algæ and the like, were the first to appear, and the most highly developed, the flowering plants the last. Each group, however, as in the case of animals, shows itself suddenly fully formed, and there are no known fossils that enable the evolutionist to trace the descent of any group from any other.

These assertions are supported by the following statements of botanists:

"Persistence of types and apparently, from time to time, sudden influxes of new types, rather than a steady progressive development, are among the outstanding features of the history of plant development." [1]

"The permanence of species and the rapid transitions which nevertheless connect them among themselves suggest that their mutations must have been in the nature of metamorphoses, or perhaps, in opposition to the well-known axiom, by leaps; certain consecutive forms presenting different characters between which the mind can conceive no middle term; the cases of sudden change are by no means rare." [2]

Probably few realize how unfavourable is the testimony of the fossils to the doctrine of evolution, because most biologists are specialists who pay little attention to theory. They accept without question the assertions of textbooks regarding evolution and these—

(1) Make light of the lack of evidence of the origin by evolution of the classes or orders of animals.

(2) Lay great stress on the fossils proving that in the past organisms have undergone *some* evolution or differentiation.

(3) Adduce as evidence of evolution a multitude of facts which are capable of another interpretation; some of these are definitely *not* evidence of evolution, others may be evidence of evolution, but this has yet to be proved.

As an example of the former the shells of Ammonites may be cited. Some of these many-chambered shells are straight, some loosely coiled, others closely coiled. This is taken as proof of the evolution of the loosely-coiled shells from straight and closely-coiled shells from loosely-coiled ones.

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[1] Professor Seward in *Progs. of the Geological Society of London*, Vol. LXXIX, Part 2 (1922).

[2] C. Grand'Eury.

As D'Arcy Thompson has pointed out [*On Growth and Form* (1917)], there is no justification whatever for this opinion. The form of a tubular shell is determined entirely by the ratio in the rate of growth of the outer as compared with the inner border. If the two edges grow equally fast the shell is straight, if one border grows faster than the other the shell is coiled, and the closeness of the coil depends on the difference of the rates of growth of the edges. There is no question of one form being the most primitive or ancestral to the others.

Palæontology lends no support to the evolutionary interpretation of the coiling of the shells of the Ammonites. Only one genus—*Bactrites*—is known of which the shell is straight; this occurs in the Devonian in company with loosely- and closely-coiled forms. Moreover, all three types of shell may occur in the same family.

Coming now to facts that may be, but are not proved to be, evidence of evolution. Speaking generally, the later ichthyosaurs are larger than the earlier ones, their limbs relatively shorter, their skulls longer, their vertebræ shorter and more like those of fish, and the bend of the backbone in the tail region more pronounced. These differences may be the result of evolution, but, in default of a phylogenetic series of fossils proving this, they are not positive evidence of evolution. The fact that a certain group of animals is represented in the Devonian period by forms A, B, C, etc., and in the Trias by forms W, X, Y, etc., is not proof that the members of the first series were gradually transformed into those of the latter. They may be in no way related; the one may have replaced the other. If the differences between the earlier and later forms are slight they are probably the result of evolution, if great it is probable that there is no genetic connection between the two sets of animals. But even if the differences are slight, it is not safe, in default of intermediate fossils, to cite the change as evidence of evolution. The bare fact that an animal has but three digits to each foot is not proof that it evolved from a five-digited form.

The greater part of that which is cited as evidence of evolution is made up of facts that may be nothing of the kind.

The correct scientific attitude is to decline to admit that any evolution has taken place unless it is supported by what is clearly a phylogenetic series of fossils.

This is not the attitude of many biologists. "Geology," writes Dr. F. A. Bather, "gives only a succession of fossil forms; the relation of them to one another is interpreted through facts of anatomy and development and seen to be an evolution." He should have written "*imagined* to be an evolution," or "*misinterpreted* through facts of anatomy and development, and seen to be an evolution."

This attitude almost inevitably leads to error. To illustrate. Mr. X was seen in London at 8 p.m. on Monday, and in Edinburgh at 8 p.m. on the following day. He was timed to run 200 yards in 22 seconds. The interpretation put on these facts is that Mr. X covered the 378 miles between London and Edinburgh on foot.

The fossils show that animals undergo comparatively slight changes in course of time, and that the fauna of each successive geological period differs from that of the preceding one. The interpretation put on this is that all existing organisms have descended from a common ancestor.

Some biologists appreciate the fact that the lack of fossils intermediate between the great groups requires explanation unless the doctrine of evolution in any of its present forms is to be abandoned.

We pass on to a consideration of the various explanations offered.

X

EXPLANATIONS OF THE LACK OF INTERMEDIATE FOSSILS

THE lack of fossils intermediate between the great groups of animals and plants is usually attributed to the imperfection of the geological record and our limited knowledge of it.

Darwin and Wallace laid great stress on this.

> "For my part," wrote Darwin [*Origin of Species* (1882), p. 289], "following Lyell's metaphor, I look at the geological record as a history of the world imperfectly kept, and written in a changing dialect; of this history we possess the last volume only, relating only to two or three countries, of this volume only here and there a short chapter has been preserved; and of each page only here and there a few lines."

Wallace is even more emphatic. He writes [*Island Life* (1892), p. 70]:

> "The theory of evolution absolutely necessitates the former existence of a whole series of extinct genera filling up the gap between the isolated genera which in many cases now alone exist . . . proofs of such former continuity are continuously being obtained by the discovery of allied extinct forms, but the extreme imperfection of the geological record as regards land animals renders it improbable that this proof will be forthcoming in the majority of cases. The notion that, if such animals ever existed, their remains would certainly be found is a superstition which, notwithstanding the efforts of Lyell and Darwin, still largely prevails among naturalists, but until it is got rid of no true notions of the former distribution of life upon the earth can be attained."

One thing is certain, either the doctrine of evolution is false or the geological record is exceedingly imperfect and our knowledge of it very incomplete.

The number of orders of animals and plants capable of being fossilized, that is, possessing hard parts, that have appeared since the Cambrian cannot be less than 450. On the moderate assumption that 12 successive genera directly ancestral and 48 collateral genera linked each order with the group from which it evolved, some 27,000 intermediate forms, direct and collateral, must have existed in the past linking all these orders with the groups from which they arose. So far we have discovered only two supposed intermediate fossils. Therefore, either the evolution doctrine, as now usually enunciated, is false or we know as fossils only 1 in 13,500 of the extinct genera capable of being fossilized.

The question then arises: did these supposed 27,000 intermediate forms ever exist?

The answer appears to be in the negative, for the following reasons: Although an animal can be preserved as a fossil only if it become buried soon after death, because otherwise its hard parts are destroyed by the action of air and water, theoretically the chances are greatly in favour of some individuals of every genus, having a skeleton or shell, becoming fossilized.

The geological record in respect of such forms ought to be nearly perfect, even though the sediment in which were buried the fossils of very ancient forms has in many cases been swept away by denudation. Denudation would result in the component parts of the skeletons in a layer becoming dissociated, but many of these would be preserved in the new deposits, as isolated bones, teeth, etc. A large proportion of the fossils known to us consist of such isolated parts.

The chances of a genus leaving any fossils depend on the duration of the existence of the genus and the average number of the individuals that compose it during its existence, in other words, on the total number of its individual members.

The longevity of genera varies enormously. Some genera can be traced back by means of fossils to the Cambrian, others only to the Pleistocene. Thus, the duration may last from some two million to some four hundred million years. There seem to be few genera, even among mammals, of which the duration is less than five million years.

As regards population, that of some species and genera is prodigious. The phosphorescence of the sea, so noticeable in some parts as a ship ploughs its way through it at night, is due to the fact that in it live myriads of the luminous protozoa, *Noctiluca miliaris*.

The seas teem with this and many other tiny organisms. It has been calculated that forty million square miles of the bed of the ocean are covered with the *débris* of the Forminifer *Globigerina*, and over sixteen million square miles with the remains of *Radiolaria*. Chalk, sandstone and other rocks are mainly composed of the fossils of the Protozoa, and coal-beds are made up largely of fossil plants.

In the case of big animals such enormous populations do not occur for the simple reason that the earth could not support them. But few genera can have existed of which the average population during their existence amounted to less than a million.

Nor can many have had a duration of existence less than ten million years. The odds are greatly in favour of some of these millions of individuals becoming fossilized during these millions of years. Sudden burial may result from sandstorms, floods, rain of volcanic ashes, streams of pitch, immersion in bogs and quicksands, avalanches, landslides, earthquakes, and, in the case of insects and the like, immersion in resin exuded by trees. Such calamities are not infrequent, and it is almost certain that many individuals of every genus must have been overtaken by them during the long period of the existence of the genus to which they belong.

The animals least likely to fall victims to such calamities are those able to fly. In fact, the known fossils of birds and bats are relatively few. Arboreal creatures are less liable than ground animals to be overcome by many of the calamities mentioned above; the fossils of the former are less numerous than those of the latter. It may be that the geological record is imperfect in respect of winged organisms, and it is very imperfect in the case of organisms possessing neither skeleton nor shell.

In the case of delicate forms it is probably far from perfect, because the majority of the fossils of such must have been destroyed by denudation and other agencies.

As regards marine animals possessing shells, the record should be nearly perfect, and it should not be very imperfect in respect of all organisms having hard parts, other than those enumerated above. On the other hand, our knowledge of the fossils embedded in the earth is incomplete. Those known to us are almost certainly considerably fewer than those embedded in the crust of the earth that have not yet been discovered.

As regards our knowledge of the geological record, palæontological exploration has been carried out in every country of Europe, including the Faroes, Mediterranean islands, Greenland and Spitzbergen, in most parts of the United States of America, in Canada, Central America and many parts of South America, including Mexico, Brazil, Patagonia, the Argentine, Bolivia, Chile, Ecuador and San Domingo, in several parts of Africa, such as the Sahara, Egypt, the Gold Coast, Tanganyika and South Africa, in many parts of Asia, including India, Burma, the Shan States, Indo-China, Yunnan, China, Japan, Siberia, Manchuria, Persia, Arabia, Asia Minor, Syria and Armenia, in many regions of Australasia and in the Malay Archipelago, the West Indies and the Falklands and other islands.

But in most of the above areas the geological survey is far from complete, and there is much territory of which the fossils are altogether unknown. Moreover, there is a great area under the sea which was formerly occupied by terrestrial forms, many of the fossils of which are lying hidden beneath the sea. On the other hand, most genera and families at some time of their existence are widely distributed, and so many inhabiting land now submerged must have been fossilized in areas now above water.

Fortunately in estimating the extent of our knowledge of the fossils and the degree of perfection of the geological record we are not dependent on theory; there are data—concrete facts—that enable us to fix the maximum of the imperfection of the geological record.

That no attempt to accomplish this, despite the fact that the fossils necessary to demonstrate the truth of the theory of evolution are not forthcoming, is one of the consequences of the ready acceptance by scientific men of the philosophical conception of evolution.

Another consequence is that, despite the fact that the Darwinian theory is founded on the assumption that living organisms are subjected to a ceaseless struggle for existence resulting in the survival of only the fittest, no inquiry into the nature and effects of this struggle was made until 1924, when I attempted this in the case of the birds of India. This investigation led to the conclusion [*Indian Bird Life* (1925)] that the majority of the causes of death have no selective value and therefore the potency of natural selection has been overestimated by Darwin and his followers.

The data available for fixing the maximum imperfection of the geological record are: the number of living genera of each group of organisms and the number of these living genera of which fossils are known. The ratio the latter bears to the former must show the minimum extent to which living genera have been fossilized.

In the case of extinct genera the ratio almost certainly is not less. It is most desirable that such a survey be made for every class of organism. It would furnish a solid foundation on which to base an estimate of the completeness or otherwise of the geological record.

A survey of the mammals now living in India, compiled from the *Fauna of British India* and Volume III of von Zittel's *Textbook of Palæontology*, shows that fossils of 61 of the 116 genera of mammals now living in India have been found:

INDIAN MAMMALS

Type of Mammal.	No. of Genera now Living.	No. of Genera of which Fossils are known.	Ratio of Genera of which Fossils are known to Living Genera.
Aquatic	14	7	50%
Arboreal	41	8	20%
Terrestrial	61	46	75%
Total	116	61	52%

These figures do not disclose the full extent to which mammals are fossilized, because:

1. All the above genera are still living. Some may have millions of years of existence before them, and in

future many fossils of them will be laid down. Of the 55 genera of which fossils have not yet been found 24 are genera that contain only one species apiece; this indicates that such are either comparatively new genera that have not yet had time in which to split up into several species, or genera on the verge of extinction.

2. India has not yet been fully explored palæontologically, and it is highly probable that fossils will yet be found of some mammals of which fossils are not now known.

In the case of aquatic mammals many fossils must exist which are at present buried beneath the sea: this is doubtless the reason why the percentage of aquatic is smaller than that of terrestrial fossils.

3. An analysis of the 33 arboreal Indian genera of which fossils are not known shows that 3 of these are members of the Muridæ (rat family), measuring less than 5 inches from snout to vent. Fossils consisting of parts of skeletons of such minute forms are apt to be overlooked. Eighteen of these genera are bats, of which 13 are (apart from the tail) only from 1½ to 3½ inches long, and 3 belong to genera represented by but one species apiece.

4. An analysis of the 15 terrestrial genera of which fossils have not been found shows that 5 of these are so like other species of which fossils are known that it may be doubted whether they are entitled to generic rank, and it may well be that fossils represented by parts of their skeletons have been attributed to the more common allied genera. These are *Cynælurus* (hunting leopard), which closely resembles *Felis*; *Viverricula*, which is difficult to distinguish from a small species of *Viverra*; *Melursus* (sloth bear), which is very like *Ursus*, indeed the fossil *Ursus theobaldi* may well be an ancestor

of *Melursus*; *Cemas* (gooral) very like *Nemorhædus* (serow) and *Pantholops* (Tibetan antelope) very like *Antelope*. Of the remaining 10 genera of which fossils have not been found, 8 are mice and shrews, none of which measure as much as 5 inches from snout to vent, and 2 very rare forms.

The above facts seem to indicate that a genus of mammal leading an ordinary terrestrial life is unlikely to escape fossilization during its existence; this is probably true of aquatic mammals. On the other hand, it is not improbable that a percentage of arboreal genera may escape fossilization.

It is necessary to bear in mind that all the above fossils are from comparatively recent layers, which have not been subjected to so much denudation as older strata. In consequence the latter may be less rich in fossils owing to some which they once held having been swept away; but probably many of those so disturbed are preserved in an incomplete state in their new resting-place.

The above data are not sufficient to enable a definite estimate to be made, but they demonstrate that the imperfection of the geological record is not nearly so great as it is usually said to be.

Clearly then, if organisms ancestral to the great groups of animals existed, hundreds of their fossils and thousands of those of their collaterals ought to have been unearthed ere now.

The above test is confirmed by one of a different kind. According to the doctrine of evolution every order and other group evolved gradually from an earlier group; therefore each group must have been preceded by a long line of ancestors linking it with the group from which it arose, and in most cases many collaterals must have existed. Therefore, the number of the fossils of these ancestors and collaterals discovered in the layers of the period immediately previous to its appearance should be not less than the known fossils of the group found in the layers of an equal period following its appearance.

Applying this test to the Cetacea and Sirenia, in the Middle and Upper Eocene fossils of six cetaceans and five sirenians have been found; this means that six fossils of forms ancestral to the cetaceans and five to the sirenians ought to have been discovered in the Lower and Middle Eocene. Moreover, as these two groups are very unlike all other mammals, their ancestors must have differed considerably from members of all other groups long before the middle of the Cretaceous. From that period, therefore, at least twenty fossils of the more remote ancestors of each group ought to have been found. In fact, not one is known.

Obviously, then, the state of the geological record and that of our knowledge of it afford utterly inadequate explanations of the lack of fossils revealing the evolution of the orders and greater groups. At the most they would account for gaps in the chains of intermediate fossils.

This is recognized by many zoologists, who supplement these explanations by invoking migration.

The term "migration" must be understood in its widest sense; it includes the carriage of seeds by the wind and the conveyance of marine forms by currents in the sea. We must bear in mind that the sudden appearance of new forms is not confined to animals capable of locomotion.

"Just as we have seen branches at their highest point end by abrupt extinction," writes Dépéret [*The Transformations of the*

Animal World (1908), p. 280], "so it seems that the majority of them appear abruptly and complete, as if they had been created altogether in the region under observation. This *apparent arrest* at the outset of the evolution of each branch is explained by the sudden arrival of the group in the region of the globe under study."

This would be a satisfactory explanation but for the fact that in no case in which an altogether new type appears has there been found in any part of the earth a fossil indicating that the new type has evolved from any other. If migration and dispersal afford the correct explanation of the sudden appearance of all the larger animal and vegetable groups, then practically the whole of evolution, that is, evolution as opposed to mere differentiation, took place in parts of the earth that have not been geologically explored.

Thus, there is no getting away from the fact that the above three explanations taken together fail to account for the complete absence of intermediate fossils. This being so, the hypothesis of evolution must be either abandoned or so modified as to explain this lack of fossils.

The explanations of this that entail a modification of the theory of evolution as held by Lamarck, Darwin and other evolutionists of last century are:

(1) Transformations of one type of organism into another have always been effected in a comparatively short space of time.

(2) Such transformations have been the result of "clandestine evolution."

(3) Every type of organism evolved independently from amorphous colloidal matter in the sea.

(4) The transformation of one type into another has always been effected *per saltum*.

Transformations have been effected in a comparatively short space of time.

We have already criticized (see p. 12) Cuénot's belief that the main types have arisen comparatively suddenly, in consequence there was little time for the laying down of fossils of transitional forms. Professor H. F. Osborn's theory of adaptive radiation assumes that new types after their appearance have given birth comparatively suddenly to divergent and radiating lines of offspring each of which adapts itself to its peculiar surroundings, in consequence, in a relatively short time, the original type exhibits considerable variety of form.

Theories of this kind, equally with that of creation, are open to the objection that we know of no natural forces capable of causing such rapid transformations. Moreover, Osborn's theory requires some intermediate fossils, which are not as yet forthcoming.

Transformations are the result of clandestine evolution.

This theory has recently been enunciated by G. R. de Beer [*Embryology and Evolution* (1930), p. 30], who thus describes it:

> "It is, perhaps, worth stressing the fact that if a novelty appeared and only affected the young (i.e. embryonic or larval) stages of ontogeny in a race, that race would not show any phylogenetic progression, since that is measured only by adult modification. It is therefore possible to imagine that a certain amount of 'clandestine' evolution of qualitative novelties may take place in the young stages of development while the adult stages are peacefully undergoing quantitative changes. Such an evolution of structures in the young is well known and called cænogenesis, or youthful adaptation. If now neotony occurs, and the animals become sexually mature in the young condition, the phylogeny will undergo an unexpectedly abrupt modification, and start off in a new direction altogether. . . . Is it not possible that these gaps (i.e. lack of intermediate fossils), that these discontinuities in the

phylogenetic series of adults, may be also to a certain extent due to 'clandestine' evolution in the young stages followed by neotony and the sudden revelation of these hidden qualitative novelties?"

This theory, as its author candidly admits, does not provide an explanation of evolution and only partially explains the lack of intermediate fossils. Clandestine evolution followed by neotony would not account for the absence of fossils linking ordinary mammals with whales and bats.

Every type of organism has had an independent origin.

This is the theory of Sergi (*Come la paleontologia rivela l'origine. Scientia*, 1921), according to which living matter originated in the sea. When first formed it was amorphous; then small quantities of it formed themselves into non-cellular, or unicellular, and multicellular organisms; the latter developed directly from the amorphous substance without passing through a unicellular stage. Later, by processes analogous to those in the embryonic and larval development of the individual, but extending over millions of years, the various unicellular and multicellular organisms gave rise to the various types. Each type has been formed independently of every other type and has no progenitors. No type is ever transformed into another type. A type in course of time may undergo modification, but the change is always within the limit of the type. Each type makes its appearance, not as a single individual or pair, but as a group of diversified forms.

This hypothesis avoids one great obstacle that the prevailing theories of evolution have to surmount, namely, the difficulty in believing that any unicellular plant or animal changed its whole organization and became pluricellular. Unicellular organisms have flourished exceedingly since the Cambrian, why, then, the supposed transformation?

This theory also accounts for the fact that whenever we are able to trace the descent of two allied forms their lineages never meet in a common ancestor.

But, unless Sergi's theory be one of creation or clandestine evolution, it fails to account for the absence of fossils leading up to each type; moreover, equally with a theory of creation, it is open to the objection that we know of no natural forces capable of effecting the transformations it postulates.

The transformation of one type into another has always been effected suddenly, per saltum.

All theories of this kind, no matter what their authors call them, are in effect theories of creation.

As Parker considered himself an evolutionist, his theory of transformation must be deemed an hypothesis propounded in order to make the doctrine of evolution fit the facts.

He writes (*On Mammalian Descent*, p. 29):

> "Whenever and wherever it became necessary that the higher tracts of the earth should be peopled with semi-terrestrial and terrestrial forms, then I suppose these leaps of life to have taken place. The morphological force—the indwelling spirit of protoplasm—actually did perform these wonders: thus we have still living in abundance reptiles that crawl upon the earth, mammals that march and gallop over it and fowls that fly in the firmament of heaven."

This theory accounts for the absence of intermediate fossils, but it explains nothing. The expressions "indwelling spirit of protoplasm," "growth force," "entelechy," etc., may have an impressive appearance, but do they offer a more scientific explanation of the origin of new types than the invocation of Divine intervention?

It is submitted that none of the above attempts to bring the theory of evolution into line with the known facts has met with success and that therefore the correct scientific attitude, in the present state of knowledge, is to recognize that in the past new types have made an abrupt appearance, and to admit frankly that at present we are quite unable to point to any natural forces capable of originating them; in other words, to revert to the !! theory of creation.

Vialleton and Dacqué have taken this course. They recognize that new types have originated suddenly, but, save by asserting that these are probably the result of sudden changes in embryonic development, offer no physical explanation of the phenomena.

Vialleton's view is that the various groups into which the animal kingdom is divided are not all based on the same criteria; phyla, classes and orders are founded on the modalities of the organization of their members, while the lesser groups are based particularly on form. In consequence Vialleton describes the former as *Types d'Organisation* and the latter as *Types formels.*

> "Between these two groups," writes Vialleton [*Morphologie Générale* (1924), p. 675], "there is a fundamental difference. The first includes types that differ from one another in their very nature, because each of them results from a peculiar development of the embryonic rudiments (*ébauches*) of the phylum; in consequence it is not merely the perfection or reduction of neighbouring types, but something different. The second, on the contrary, includes categories all of the same nature, of which the different terms are distinguished only by more or less accessory details, or by their form."

The most comprehensive of the Types of Organization is the phylum.

> "The essential characters of this are imparted by the mode of the growth of the embryonic layers and by the architecture resulting

therefrom . . . this architecture constitutes the only general character of the phylum—a very precise character despite its generalness, because of the difference between it and the architecture of other phyla. In the phylum form is represented merely by the superposition of the parts and can be exhibited only by transverse or longitudinal sections, which permit the perception of this superposition, but nothing more. Thus, it is impossible to imagine the contour of a mollusc, an echinoderm, an arthropod or a vertebrate; the attempt to do so inevitably leads to representations, not of the general type, but of one of its expressions. . . . The class, like the phylum, cannot be characterized by its form, because its features are drawn entirely from the central parts and derive nothing from the peripheral parts, such as the embryonic rudiments of the limbs, which will give rise later, by their specialization and the correlations this entails, to the secondary types of each class—the orders. These embryonic rudiments are at first in an undifferentiated condition, capable of taking various dispositions, so as to produce, for examples, the wing of the bat, the paddle of the dolphin, the leg of the lion or the horse, the arm and hand of man. . . . In the orders the organization of the class becomes determined as regards the relations of the organs, especially those of locomotion. Thus, the fore limb of a carnivore, formed for locomotion and seizing prey, will become a paw with five toes ending in claws, the fore limb of a cetacean will become always a paddle, that of the Chiroptera a wing, and so on. But several forms of wings and paddles are possible, that is why the order, equally with the preceding divisions, is not yet characterized by a determined and constant form. In order to define an order it is necessary to have recourse to its organization, that is to say, the general characteristics of its chief apparatus, to the dentition or the limbs, closely correlated to the ordinal type. . . . Below the order organization no longer operates in establishing systematic categories, because all these groups have an identical organization —that of the order. On the other hand, they exhibit many well-marked differences, of which the principal is form. By form is meant the exact outline of an organism, stripped of extravagant tegumentary excrescences. . . . Formal types are represented by general forms known as sub-orders or super-families. These forms are in effect modality types which a given organization can assume to adapt itself to various functions, or the different places it can occupy in nature. As a result of these adaptations the formal types are in turn divided into the secondary categories below sub-orders and super-families. . . . The subdivisions of the formal types do not present among themselves the opposition exhibited by the types of organization; being composed of organisms of the same nature they represent quantitative differences, or rather the details of the outer parts and accessories of which nature produces an exuberance and a prodigality, that, as Cuvier remarked, are beyond our comprehension."

Vialleton asserts (*loc. cit.*, p. 679) that a new type of organization can originate only by a special development effected in the egg in the earliest phases of ontogeny, which absolutely excludes the process of phylogenic development required by the doctrine of evolution.

On the other hand, many of the formal types may originate in the latter manner, but he is of opinion that certain of these, very sharply defined and very isolated, have originated independently of their nearest neighbours by a change in an early stage of embryonic development, as in the case of orders. Others, not so clear cut, and the secondary subdivisions owe their origin to less profound transformations depending on conditions and functions, as evolutionists incorrectly imagine in the case of the bigger groups.

The conclusion of the whole matter is that the theory of evolution is beset with difficulties and the fossils known to us seem to indicate that, while most organisms have undergone considerable gradual modification in the past, new types often, if not invariably, appear abruptly, usually in some diversity.

It would seem, then, that a new organism may originate in one or other of two ways: by a slow process of evolution or a rapid process of creation.

The organisms *proved* to have arisen by the former process seem never to differ very greatly from the most remote of their ancestors to which it has been possible to trace them through a genealogical series of fossils.

This being so, in order to account for the phenomena presented by living organisms it would appear to be necessary to adopt a provisional hypothesis of special creation, such as that formulated by Vialleton, supplemented by a theory of evolution.

Such a course would certainly stimulate research. It would lead to systematic efforts to discover the extent to which organisms are proved to have undergone gradual modification in the past. When this is determined we shall know precisely what evolution has to account for. The next step will be to try to discover the causes (stimuli or forces) which have brought about the sudden transformations that seem to have taken place. In such circumstances histology, physiology and morphology will gain a new vitality and embryology and biochemistry will become of even greater consequence than they now are.

APPENDIX I

A NOTE ON CLASSIFICATION

As frequent mention is made in this book of phyla, orders, families, genera and species, the non-zoological reader may find the following remarks on classification helpful.

So great is the multitude of organisms and so diverse are their forms that some system of classification is essential to their study. The man of science endeavours to classify them naturally, i.e. to arrange them in divisions founded on fundamental points of structure. To this end organisms are divided into two main groups—the Animal and the Vegetable Kingdoms. The members of each kingdom exhibit much diversity, nevertheless a study of their anatomy shows that the construction of every one of them is based on one or other of about a score of plans. Each plan differs fundamentally from the others.

In the case of the animal kingdom it is obvious that the general plan of the architecture of a starfish differs fundamentally from that of a lobster or a crocodile, and this is equally true of the plans of construction of the two last.

Zoologists place in the same group all the organisms constructed on any one of these plans, no matter how greatly they differ from one another. Each of these main groups of a kingdom is known as a sub-kingdom or, to use the name given by the evolutionist, a phylum. Thus, all animals constructed on the same plan as the starfish, i.e. of which the parts are arranged radially, are known as the *Echinodermata*. This sub-kingdom or phylum comprises such forms as sea-lilies, sea-cucumbers and sea-urchins.

Again, all animals that exhibit a backbone: fish, amphibia, reptiles, birds and mammals, are grouped together in the sub-kingdom Vertebrata. Evolutionists deem the Vertebrata but a sub-phylum. They tack on to it several groups of very different organisms—Amphioxus (the lancelet), Balanoglossus and its allies and the sea-squirts, and call the whole the phylum *Chordata*, because these organisms, either in the larval or adult state, exhibit a notochord (see p. 52). Animals sometimes find themselves in strange company when classified by evolutionists!

Most of these phyla or sub-kingdoms constitute a very varied assemblage of animals. In consequence each is divided up into a number of subordinate groups known as classes. Thus, the sub-phylum Vertebrata is divided up into the Cyclostomata (lampreys and hag-fish), Pisces, Amphibia, Reptilia, Aves and Mammalia, and the Phylum Echinodermata is divided up into seven or eight classes, of which members of the following are now living: Crinoidea (sea-lilies), Holothuroidea (sea-cucumbers), Asteroidea (starfish), Ophiuroidea (brittle starfish) and Echinoidea (sea-urchins).

Nearly all the classes into which sub-kingdoms are divided are exceedingly large groups, of which the members are very diversified. Thus the bat, whale, elephant and mouse all belong to the Class Mammalia. In consequence each class is divided into smaller groups known as orders. Sometimes several orders are grouped together to form a sub-class. Each of the above mammals is deemed a member of a different order. Thus the bat belongs to the Order Chiroptera, or winged mammals, and the mouse to the Order Rodentia, or gnawing mammals.

The majority of orders are large groups of which the members display considerable diversity, in consequence they are divided into smaller groups called families. The Order Carnivora includes such animals as cats, dogs and bears. Each of these is deemed to belong to a different family: the dog to the Canidæ or dog family, the cat to the Felidæ or cat family, which includes the lion, bear, leopard, tiger, etc.

As the members of many of the families exhibit some diversity, most families are divided into smaller groups known as genera. Thus, the horse and the zebra, although both members of the Equidæ or horse family, are deemed to belong to different genera. Members of the same genus may display slight but constant differences; for this reason genera are divided into species. Thus the zebra and the quagga are two species of the same genus.

The scientific name of every animal consists of two parts, the first denoting its genus and the second its species. Thus the wolf is called *Canis lupus* and the jackal *Canis aureus*. Both are members of the Canidæ (dog family) and belong to the same genus, but to different species of this genus. The Canidæ is a family of the Order Carnivora, which is an order of the Class Mammalia, which in turn is a class of the sub-kingdom Vertebrata. Thus, every animal finds a place in a regular cadre.

The above system of classification was devised before the doctrine of evolution was resuscitated. This doctrine, however, gives the system a new meaning. According to the evolutionists, all the existing groups of animals evolved from earlier groups, and these in turn from still earlier ones, and so on until all join up in a common ancestor.

From this it follows, if the doctrine of evolution be true, all members of the same family have a common ancestor—the earliest animal from which the family evolved; all of the same order have a common ancestor, the animal from which the order evolved; all of the same class a still more remote ancestor, the animal from which the class evolved, and so on.

The evolution theory has led to a number of changes in the old classification to bring it into line with the doctrine. For example, evolutionists recognize that all members of the Order Ungulata or hoofed Mammals cannot have arisen from one primitive hoofed animal, their diversity is too great; in consequence evolutionists deem this to be not a natural order, but a composite one, and they would divide it into several orders; but there is no agreement as to how it should be split up.

Perhaps the best method of conveying to the non-zoological reader some idea of the wealth of animal life is to set forth the various orders of the Vertebrate class Mammalia. The classification here given is but one of many. Some would split up several of the orders into two or more.

Extinct groups are excluded.

Class Mammalia

Sub-Class I: *Monotremata*, or *Prototheria*, or *Ornithodelphia*.

Among the distinguishing features of this sub-class are: its members lay eggs; their mammary glands have no nipples; no placenta is developed; the two uterine dilatations of the oviducts do not coalesce but open separately into a cavity, which in turn, together with the rectum, open into a common "cloaca."

This is a very small sub-class. It contains only two living genera: *Ornithorhynchus* (duck mole) and *Echidna*.

Sub-Class II: *Metatheria*, or *Didelphia*, or *Marsupialia*.

This division includes only one order—the marsupials—that contains a number of families. Among the distinguishing features are: the mammary glands have nipples; eggs are not laid; no placenta is developed; there is no cloaca.

To this order belong the American opossums and shrew-like Cænolestidæ, and the phalangers, kangaroos, bandicoots and nearly all the mammals indigenous to Australia.

Sub-Class III: *Eutheria*, or *Monodelphia*, or *Placentalia*.

These have no cloaca and are distinguished by the possession of a placenta which enables the young to remain in the uterus until they are comparatively well-developed. To this group belong all the higher mammals. It is divided into a number of orders:

1. *Edentata*. Characterized by the fact that their teeth exhibit no true enamel. To this order belong the sloths, armadillos, ant-eaters, etc.

2. *Sirenia*, or Sea-cows. These are fish-like in appearance. They are distinguished from the Cetacea by the fact that their mammæ are in the chest region. The manatees and dugongs are examples.

3. *Cetacea*. These are fish-like mammals in which the mammæ are abdominal. Whales, porpoises and dolphins are examples.

4. *Ungulata*, or Hoofed Mammals.

These may be divided into four sub-orders:

(*a*) *Perissodactyla* or Odd-toed Ungulates. Examples of these are the horse, rhinoceros and tapir.

(*b*) *Artiodactyla* or Even-toed Ungulates.

Examples of these are the cow, deer, hippopotamus, giraffe, camel, sheep, antelope.

(*c*) *Hyracoidea*. This is a small group containing only the genus *Hyrax*, which is believed to be the coney of Scripture. Some regard this as a separate order.

(*d*) *Proboscidea*. The elephants are the only living members of this sub-order.

5. *Carnivora*. The members of this order have the teeth adapted to tearing up large quarry. They are usually divided into two sub-orders:

(*a*) *Pinnipedia*, or Aquatic Carnivores. To this group belong the seals, sea-lions and walruses.

(*b*) *Fissipedia*, or Terrestrial Carnivores. Examples of these are the wolf, bear, civet cat, hyæna.

6. *Rodentia*, or Gnawing Mammals. This includes the rat, squirrel, rabbit and beaver.

7. *Chiroptera*, or Winged Mammals. This order contains the bats.

8. *Insectivora*. This contains the mole, hedgehog and, according to some, the flying lemurs. Others would make a separate order of the last.

9. *Primates*. This includes the monkeys, apes, and lemurs. Most authorities include man in this order, but, as has been remarked, man is a law unto himself and, if we take his psychic characters into account, deserves to be regarded as a separate sub-kingdom.

As regards the criteria on which phyla, classes and the smaller groups are based, see p. 155.

APPENDIX II

SOME ANATOMICAL CHARACTERS OF BIRDS DIFFICULT TO RECONCILE WITH THE DOCTRINE OF EVOLUTION

If, as evolutionists believe, birds evolved from a reptilian ancestor, every organ or structure they possess must either be inherited in a more or less modified condition from that ancestor or be an entirely new structure acquired in the course of evolution.

Of organs seen in birds but not in reptiles mention may be made of feathers, the cæca, the oil gland, the ambiens muscle and the syrinx.

Evolutionists believe feathers to be modified reptilian scales; if this be so feathers are modifications of reptilian structures rather than new organs.

The cæca, however, appear to be entirely new organs. They are blind diverticula of the gut at the junction of the large and small intestines. The entrance to this diverticulum is guarded by a valve. In some birds the cæca attain great dimensions, in others they are small. Some have no cæca. The function of these organs is not yet known. Neither their presence or absence, nor their magnitude, seems to be correlated to the nature of the food eaten.

The oil gland is a structure not found in any known reptile. It is situated on the lower back above the root of the tail. It secretes an oily fluid. Formerly it was thought that this oil was used to dress the feathers; but the plumage of birds which lack this gland is as spruce as that of those possessing it. According to Paris, the gland may be removed without apparent harm to a bird. On the other hand, if the nipple of the gland becomes blocked, a bird sickens and dies unless the blockage be removed.

The ambiens is quite unlike any reptilian muscle. It arises from the pelvis immediately under the thigh joint, runs to the knee, where it becomes a tendon curving round the knee in a tunnel, after which the tendon doubles back on the outside of the leg to join one of the muscles serving the toes. In some birds the ambiens ends at the knee; in others the muscle does not exist, in a few rudiments of the muscle are said to occur.

Birds have no vocal chords, the function of these being performed by membranes in the syrinx. The syrinx is an organ peculiar to birds. There are several types of this. The commonest may be thus described: near the point at which the windpipe divides into the two bronchi occurs a bony case formed partly by some of the rings of the windpipe and partly by some of the bronchial rings that are membranous on the inner side. At the junction of the bronchi a bone—the *pessulus*—passes across the syrinx from back to front. To each side of this bone is attached, along its whole length, a membrane—the *membrana semilunaris*—the outer border of which is concave. Opposite each *membrana semilunaris* and attached to the inner side of the wall of the syrinx another membrane is stretched. Thus, there is on each side of the *pessulus* a pair of membranes parallel to one another. These membranes can be tightened, and so brought closer together, by the action of muscles. All birds, except some of the Ratitæ (ostriches), possess a syrinx; in some the organ is far more complex than in others.

All birds have feathers, but there are certain kinds of feathers and certain parts of feathers that are present in some birds and absent in others. The contour feathers of many birds exhibit an aftershaft, that is to say, a large branch arising from the main shaft. In some cases the aftershaft may be nearly as large as the main shaft.

A few birds exhibit tracts or patches of peculiar feathers known as powder-down feathers, because they break up into a fine powder that seems to impart a bloom to the rest of the plumage.

From the above it is apparent that some of the typically avian structures do not occur in all birds.

If the evolution theory be true the presence or absence of the above organs in each group of birds should enable us to classify all existing birds according to the extent to which they have attained the status of the complete bird, in other words, to place all birds in a cadre of which the various grades represent stages in the process of shaking off reptilian characteristics. It is not, however, possible to do this. No one dare point to any group of birds and assert authoritatively that it is the most nearly related to the reptiles, and has advanced less far along the evolutionary path than the others.

The above organs cannot be indispensable because some birds do not possess one or more of them. Other organs and structures appear to be indispensable, as they occur in every kind of bird. They fall into two classes: organs which display very little variation and those which vary to such an extent that each falls into several types.

If these types of organs and structures be the result of evolution, birds most nearly related to one another should exhibit structures of similar type. Usually this is so in what appear to be allied groups, but the exceptions are so numerous as to throw considerable doubt on the truth of the evolution theory.

Several modes of arrangement of the wing feathers are exhibited by birds. Speaking generally, all the members of an order exhibit the same arrangement, but not infrequently it happens that certain species of an order exhibit a peculiar arrangement; thus the osprey, the honey buzzard and a few other raptores differ from all other birds of prey in respect of wing feathering.

As a rule, feathers are not distributed uniformly over the surface of a bird's body; they arise in definite areas or tracts, between which are spaces, known as aptera, that are either naked or covered with down. Usually the feather arrangement (*pterylosis*) is uniform in birds of the same order; but there are numerous exceptions.

Thus two types of pterylosis occur in the nightjars: in *Steatornis* there is a marked break in the dorsal feather tract, and the ventral tract is undivided on the neck; in *Caprimulgus*, *Antrostomus* and *Nyctidromus* there is no break in the dorsal tract and the ventral tract bifurcates on the neck. Cuckoos, rails and tinamous each exhibit more than one type of pterylosis.

The avian foot differs considerably from that of the reptile. No bird has more than four toes; the ostrich has but two. The tendons that serve the toes of birds are variously arranged. Beddard [*The Structure and Classification of Birds* (1898), p. 100] distinguishes seven arrangements of these tendons. In passerine birds the two tendons remain entirely separate; in all other birds they are united, in some they are joined by a slip known as the vinculum, in others they fuse.

In passerine birds, one tendon—the *flexor longus hallucis*—serves the hind or first toe, and the other—the *flexor profundus digitorum*—serves the remaining three toes. This arrangement also occurs in gallinaceous birds, pigeons, parrots and storks, except that the two tendons are united by a single vinculum. In some birds the *flexor longus hallucis* splits up and one branch runs to the hind toe and the other fuses with the *flexor longus digitorum*. In certain birds of prey the *flexor longus hallucis* splits up into two, very low down, one branch serving the hallux or hind toe and the other fusing with the branch of the *flexor profundus digitorum* that runs to the second toe. In hornbills, goatsuckers and some other birds the two tendons fuse and the united tendon then splits up into four branches which run to the four toes. In some birds the two tendons are joined by a vinculum and below this the *flexor longus hallucis* divides into three branches running to digits 1, 2 and 3, while the other tendon supplies only the fourth toe. In the Trogons the *flexor longus hallucis* supplies the first and second digits and the other tendon the remaining toes.

Generally only one type of deep plantar tendons is found in any one order or sub-order, but this is not invariably the case: among the Coraciæ the arrangement of the tendons differs in the rollers and bee-eaters; the kingfishers likewise exhibit two types of tendons.

If each type of tendon were correlated to a particular mode of locomotion, such differences might be explained as adaptations to this. There seems, however, to be little or no connection between the type of tendon and the mode of progression. We have noticed that all passerine birds have the same type of tendon: babblers, wagtails, and starlings that spend much time on the ground; minivets, orioles and flycatchers, that rarely come to the ground; nuthatches and creepers, that run about on the trunks of trees. On the other hand, birds having other types of tendon are equally at home on the trunks of trees (woodpeckers), on the ground (game birds and waders), or in trees (rollers and broadbills).

The skull of a bird may be of one of five types:

Dromæognathous. The maxillo-palatine bones meet in the middle and the vomer is well developed.

Desmognathous. The maxillo-palatines meet in the middle line, but the vomer is small or lacking.

Schizognathous. The maxillo-palatines do not meet, and the vomer ends in a point in front.

Ægithognathous. The maxillo-palatines do not meet, and the vomer ends abruptly in front.

Saurognathous. The maxillo-palatines do not meet and the vomers are paired rods.

Speaking generally, all the birds of an order exhibit the same type of skull, but this is not invariably the case. Thus in some of the *Capitones* (barbets) and *Caprimulgi* (goat-suckers) the maxillo-palatines meet in the middle, in others they do not.

So far as we can see, most, if not all, the above structures have no direct connexion with the mode of life of a bird.

Can it be contended that it is a matter of life and death to a bird whether its vomer be pointed or blunt in front, whether its ventral feather-tract be forked or undivided on the neck?

If not, and if all living birds evolved from a common ancestor, two consequences should follow: first, the fact that a bird A has a certain type of some given structure should necessitate its being minus one, or several, of the apparently non-essential organs, because at the time the group to which A belongs branched off from the main stock, we might reasonably expect the main stock to have lost or not yet acquired at least one of the non-essential organs; secondly, two birds of which the last common ancestor was of recent date should resemble one another in respect of nearly all characters more closely than they resemble any other bird and, the more distant the common ancestor of any two birds the more should they differ in form, in other words, there should be no difficulty in classifying birds "naturally" or phylogenetically.

Neither of these conditions is fulfilled. Take, for example, the above five types of skull. According to the evolution theory all these evolved from one primitive form. This may have given rise to five lines of descendants, each having a different type of skull, or four of the lines may have branched off at various stages from the main stem, which still survives more or less unmodified. If either of these events happened, before the five types of skull had become defined some non-essential characters ought to have been lost or not yet acquired: the aftershaft, or the fifth secondary, or the oil gland, or the basipterygoids, etc., with the result that all birds having a particular type of skull would lack one or more of these particular structures. This, however, is not the case. Desmognathous birds may or may not possess an aftershaft, or a fifth secondary, or an oil gland, or an ambiens muscle, or cæca, or basipterygoid processes or powder-down feathers. This is equally true of the other types, except the Saurognathous which comprises only one order.

In this connexion powder-down feathers are of great interest, because they are found in Desmognathous, Schizognathous, Ægithognathous and Dromæognathous birds, despite the fact that they are comparatively uncommon, occurring only in herons, some parrots, frogmouths and tinamous, three kinds of birds of prey (lammergeyer, black-winged kite and the harriers), three kinds of crane and the passerine *Ochypterus*.

Thus, the evolutionist is compelled to believe either that these feathers evolved from ordinary feathers on eight separate occasions or that the first bird possessed them and the vast majority of its descendants have lost them. Most evolutionists accept the first alternative, believing them to be degenerate down feathers. They regard this as a case of "parallel evolution."

Why this degeneration should have occurred here and there among birds of divers lands and habits, so far as I am aware, no one has attempted to explain.

Another example of a structure very uncommon among birds is the *Entepicondylo-ulnaris* muscle that runs from the distal part of the humerus to the ulna. This seems to occur only in the tinamous and gallinaceous birds.

On the other hand, there are organs that occur almost universally among birds. The gall bladder is an example. This is present in most reptiles, birds and mammals. Among birds, however, it is absent in all humming birds, in all parrots save two (in one of these exceptions—the cockatoos—powder-down feathers occur). It is absent in about half of the doves. In the cuckoos it is present more often than not. It occurs in all the nightjar group with the exception of one family, and this is true of owls, herons and struthious birds. The gall bladder appears to be present in all other kinds of birds, except that, among the *Limicolæ*, Gadow did not find it in certain specimens of the curlew, the dunlin and the sanderling. Its absence in these three cases is believed to be due to individual idiosyncrasies.

The fact that such an organ as the gall bladder may be entirely absent in an individual of a species in which it ordinarily occurs affords food for thought to those who believe evolution to have been merely a gradual piling up of small variations.

Thus, from the fact that a bird possesses a desmognathous skull we cannot tell whether or not it has an ambiens muscle, or an oil gland, or a fifth secondary, or cæca, or powder-down feathers, or what the nature of its deep plantar tendons is. We are not able to assert that a bird, of which the skull is schizognathous, must lack some organ commonly found in birds.

Further, it is not possible to formulate a "phylogenetic" classification of birds that commands universal acceptance. Several attempts have been made to draw up genealogical trees of birds. No two of these are alike. It is quite easy to demolish every one of them. Let us consider that of Mr. W. P. Pycraft, given on page 57 of his *History of Birds* (1910). According to Pycraft, the Colii, Passeres and Cypselli are more nearly related to one another than to any other group, all three having recently branched off from a common ancestor.

The following table exhibits some of the characters of these three groups:—

Character.	Passeres.	Colii.	Cypselli.
1. Manubrium sterni	Forked	Forked	Forked
2. Ambiens muscle	Absent	Absent	Absent
3. Basipterygoid processes	Absent	Absent	Absent
4. Carotid arteries	One	One in some, two in others	One
5. Fifth secondary	Present	Present	Present in some, absent in others
6. Oil gland . .	Present and nude	Present and nude	Present and tufted
7. Skull . . .	Ægithognathous	Desmognathous	Ægithognathous
8. Cæca . . .	Present, but small	Absent	Absent
9. Aftershaft . .	Present in some, absent in others	Present	Present
10. Biceps slip . .	Absent	Present	Absent
11. Vomer . . .	Present	Absent	Present
12. Flexor tendons	Of one type in Colii and Cypselli, of another in Passeres.		
13. Muscles of leg	Of one type in Passeres and Colii, of another in Cypselli.		
14. Pterylosis . .	Differs in each group.		

Thus, of the above fourteen characters, the above orders have only three in common, i.e. Nos. 1, 2 and 3. Nos. 4, 5 and 9 are alike in all three orders, except in some aberrant individuals. No. 6, the oil gland, is present in all three, but is nude in two orders and tufted in one. If some aberrant individuals be excepted, the Passeres and the Colii have nine of the above characters in common, and this is true of the Passeres and the Cypselli; but the Passeres have ten of the above characters in common with the Coraciadæ (rollers) and eleven with the Meropidæ (bee-eaters). If, then, these characters have any evolutionary significance, the rollers and bee-eaters would appear to be more closely related to the Passeres than are either the swifts or the colies.

Nor is this the main objection to Pycraft's phylogenetic tree. As the skull of the colies is desmognathous, while that of the passeres and swifts is ægithognathous, Pycraft has to assume that one or other of these types of skull evolved more than once, because there are several other desmognathous groups of birds which appear as side branches of his genealogical tree, and the Turnices (bustard quails)—a group placed by him far from the Passeres—have an ægithognathous skull.

Pycraft's tree has been selected for special criticism not as being a particularly bad one; it is as good as any other, and better than most, because nearly every one of these is based on a consideration of one particular structure or organ, and no system of classification can be natural that does not take into consideration *every* structure of *every* animal.

As regards the other attempts at natural classification, we have already noticed T. H. Huxley's effort to classify birds according to the types of skull.

Garrod and Beddard attempted independently to draw up a classification based on the presence or absence of the ambiens muscle. Garrod assumed that the common ancestor of birds possessed this muscle and that those lacking it or in which it is comparatively undeveloped, have lost or are losing it in the course of evolution. Beddard, on the other hand, believed that the muscle is not inherited from a reptilian ancestor, that the ancestral bird did not possess it, because [*Structure and Classification of Birds* (1898), p. 163]:

> "The remarkable peculiarities of this muscle seem to forbid the notion that it is the direct descendant of anything reptilian, and we have the undoubted fact that, apart from the possible

rudiment already referred to, it is present in no pico-passerine bird. If it had disappeared in them there would be here and there a rudiment left."

Beddard, therefore, was of opinion that this muscle has been fully acquired by some birds, partially by others, while many have not yet begun to acquire it.

It matters not whether Garrod's or Beddard's view be accepted, because any attempt to classify birds according to the presence or absence of the ambiens muscle is confronted by such awkward facts as some species of the storks, awks, petrels, pigeons, terns and parrots possess the muscle fully developed, while in others not a trace can be found. In one parrot—*Stringops*—the muscle is complete in some individuals and ends at the knee-joint in others. Classification according to the presence or absence of this muscle would separate widely the white-necked stork (*Dissura episcopus*) from the white and the black storks (*Ciconia nigra* and *C. alba*)—a separation no field ornithologist would allow. In any case, muscles are subject to great variation and so a very unsafe basis upon which to found a classification.

Equally unsatisfactory are the attempts to classify birds by the shape of the nostril, or by their pterylosis, or by the length and coiling of the small intestine.

Each of the above systems results not only in a different arrangement of birds but in the separation of species that are obviously closely allied. Thus, while nearly all passerine birds are holorhinal (i.e. the posterior end of the bony nostril ends in an oval outline), a few are schizorhinal (i.e. the bony end of the nostril ends in a narrowing chink). In some cuckoos the ventral feather tract is split into an outer and inner branch, in others it is not; an undivided dorsal tract occurs in such diverse birds as the peacock, the kingfisher and the nightingale. In the same genus, e.g. the dove *Geophila*, there may be two species in one of which the small intestine is twice as long as that of the other.

Every attempt to classify birds phylogenetically or to draw up a genealogical tree of the class has been a failure. It is submitted that the reason is, not that evolution has taken place along strange and incomprehensible lines, but that all the birds have not evolved gradually from a common ancestor; if all are derived from some primitive stock, each family or, at any rate, each order or sub-order, sprang into existence suddenly, endowed with its main characters and has since undergone comparatively little differentiation.

A survey of the anatomical features of birds indicates that there are, so to speak, available certain types of several of the indispensable organs and these types have been distributed more or less evenly among the various families, that there are some structures that may perhaps be described as luxuries, and these likewise have been distributed impartially among the various families. If anyone cares to make up fifty hands of thirteen playing cards, all different, each hand containing one card of each denomination from the ace to the king, save that, if desired, in any hand one or two blank cards may be substituted for the same number of cards of low denomination, the fifty hands so composed would represent very closely the anatomical features of fifty birds belonging to as many families, assuming that the cards of higher denominations represented essential organs and those of lower denominations non-essential structures, for example, the four kings represented four types of skulls, the four queens four types of pterylosis, the red twos naked oil glands and the black twos tufted oil glands, etc.

Were several persons asked to classify the fifty hands so constituted, some might divide them into two main classes according as red or black cards predominated; others might separate those containing blanks from those containing none. A Bridge player might divide the hands into five classes according as they justified a no-trump or a suit declaration. If some of the classifiers believed these hands to have evolved from one primitive hand they would try to classify them phylogenetically; in this case various questions would arise, whether the blanks were primitive or otherwise, whether red had evolved from black or *vice versa*. The result would be various phylogenetic classifications, all of which would be valueless, no matter how ingeniously worked out, for the very good reason that these hands did not evolve from a common ancestor.

May not this be the reason of the want of success that has attended attempts to classify birds phylogenetically?

APPENDIX III

THE ALLEGED ORIGIN OF MAMMALS FROM REPTILES

In the Upper Permian and Lower Trias lived a group of reptiles known as the *Theriodontia*, the skull of which, according to von Zittel,

> "is remarkably similar in form to that of carnivorous mammals and the dentition exhibits modification unusual among reptiles. The mandible bites within the upper jaw, and the lower canines cross in front of the upper as in mammals. Owing to the development of a secondary palate by plates from the maxillæ and palatines, the opening of the internal nares on the roof of the mouth is displaced backward as in the crocodiles and mammals. An approach to the dicondylic condition of the mammalian skull is also frequently observed."

In the Theriodont sub-order *Cynodontia* the canine teeth bear some resemblance to those of a dog. On the strength of this, although no intermediate fossils are known, evolutionists assume that mammals evolved from the Cynodont reptiles.

Even if future palæontological discoveries should prove the truth of this assumption, it is not justified in the present state of our knowledge, because it is not safe to base kinship on similarity of parts of skeletons. Teeth, in particular, are unsafe criteria on which to base affinity, because their form depends largely on the food on which their possessor subsists. As Dépéret points out, the long, thick, smooth canine teeth of the ungulate genus *Lophiodon* resemble most deceptively those of the bear family, and the canines of the Oligocene ungulate *Brachyodus* are so similar to those of the carnivore *Machærodus* that Dépéret would have unhesitatingly ascribed the teeth of *Brachyodus* to a carnivore had he not seen them *in situ* in the skull of the former.

The earliest fossils believed to be those of mammals occur in the Upper Trias. These are mere fragments of skeletons—a part of a skull, more or less complete lower jaws, isolated teeth, etc. Hence it is not possible to classify them with any degree of accuracy. They exhibit, however, considerable diversity.

Two complete lower jaws, named *Dromotherium* and *Microconodon*, have been found in the Upper Trias of North Carolina. It was formerly believed that the possessors of these jaws belonged to the marsupial sub-order *Polyprotodontia*. Dr. G. G. Simpson, however, pronounces them to be reptiles and his view seems to be generally accepted. It may here be stated that he is the author of the latest book on the early fossils of mammals—*A Catalogue of the Mesozoic Mammalia in the Geological Department of the British Museum* (1928). From the Upper Trias of South Africa part of a skull named *Tritylodon* has been unearthed. Each molar tooth of this is provided with five or more cusps arranged in rows. Dépéret and others believe *Tritylodon* to be a reptile; other authorities, including Simpson, deem it a mammal; it may be that it is neither.

Those who believe this fossil to be a mammal place it in the sub-order *Tritylodonoidea* of the Order *Multituberculata*, so named on account of the number of cusps the molar teeth exhibit. This order is sometimes called the *Allotheria*.

In addition to *Tritylodon* some isolated molar teeth occur in the Upper Trias. Of these teeth Simpson writes (*loc. cit.*, p. 54):

> "1. Having divided roots, they are probably more mammal- than reptile-like, and may be placed among the mammals.
>
> 2. They are so little known and what is known is so unlike any other group of mammals that they cannot be assigned to any mammalian group with any degree of confidence.
>
> 3. They show a distant resemblance to some multituberculates and may be placed in this order, but with the understanding that there is no decisive evidence in favour of this view and that some facts oppose it."

In later strata occur other fossils deemed to belong to the Multituberculata. Professor W. K. Gregory, who believes these multituberculates to be mammals, writes "they were probably not closely related to any other order of mammals, but were a peculiar group." They became extinct in the Basal Eocene. It is noteworthy that *Tritylodon* lacks the conspicuous canine teeth so characteristic of the Cynodonts from which evolutionists suppose mammals to have originated.

In the Jura appear three new orders supposed to be mammalian—the *Triconodonta*, the *Symmetrodonta* and the *Pantotheria*.

The Triconodonta are known only from some fossil jaws. These, unlike those of the Multituberculata, have well-developed canine teeth. The molars have three cusps arranged in a longitudinal row. This group is not linked by known fossils to any other. It seems to have been short-lived.

The Symmetrodonta are so called on account of their symmetrical molar teeth. Although fossils representing this group have been found in Europe and America, it is known only from the Jura. Simpson regards it as an aberrant mammalian order exhibiting neither marsupial nor placental affinities. He thinks it may be allied to the Pantotheria by "a rather remote common ancestry." This is pure surmise, as no fossils are known connecting this group with any other.

The Pantotheria, or Trituberculata, appear to have existed only in the Jurassic period. No fossils linking them with any earlier or later group have been found; nevertheless Simpson believes that the higher mammals and the Pantotheria may have evolved from a common ancestor, because the Pantotherian fossil lower jaw known as *Amphitherium* "represents a very early, very generalized stock, which, so far as known, provides an ideal structural ancestor for all known post-Palæocene mammals, except monotremes."

"On the basis of the facts now known," writes Simpson (*loc. cit.*, p. 182), "and without making a futile attempt to discount the future, it may justly be said that the pantotheres show no features which would show exclusive relationships with either marsupials or placentals, that they exhibit no characters which would exclude them from the ancestry of either group, and that in the known parts they display, as an order, all the characters which would necessarily appear in the common ancestor of marsupials and placentals. The characters involved are too many and too intricately co-ordinated for this to be mere coincidence or convergence, and the only conclusion possible at the present time seems to be that the Order Pantotheria does represent the ancestry of both marsupials and placentals, without itself belonging to either group."

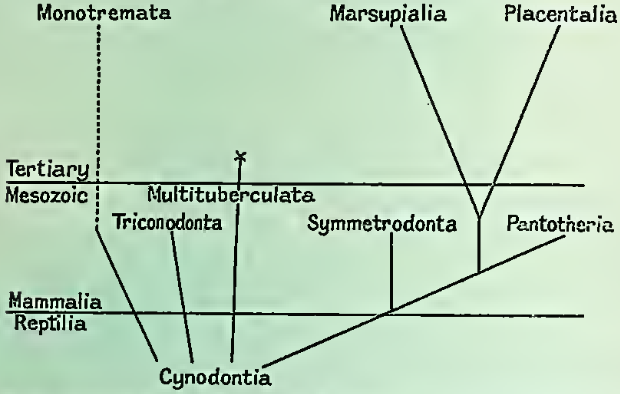
This statement, guarded and provisional though it be, seems somewhat premature, seeing that the total fossil remains on which it is based consist of lower jaws (or parts of jaws) of nine genera belonging to four families, the greater part of a crushed skull, some vertebræ and fragments of ribs of one species.

Even if this view be accepted, it leaves us in the dark as to the origin of the Pantotheria and involves the assumption that the monotremes evolved from reptiles independently of the marsupials and placentals.

The monotremes are deemed by evolutionists to be the most primitive of all living mammals; this being so, their fossils should appear earlier than those of the marsupials and placentals. Far from this being the case, whereas the marsupials and placentals appear simultaneously in the Upper Cretaceous, the earliest monotremes do not occur until the Pleistocene, perhaps fifty million years later. The earliest-known monotremes differ fundamentally from all known mammalian and reptilian fossils. "There is no known group," writes W. K. Gregory [*Encyclopædia Britannica* (1929), Vol. XV, p. 735], "of extinct Mesozoic mammals from which we can confidently derive the monotremes. Notwithstanding the widespread impression that the monotremes have been derived from the Multituberculata, recently discovered palæontological evidence weighs heavily against this view." As usual, new fossil discoveries, far from assisting the doctrine of evolution, tell against it.

Simpson's pedigree of the mammals is reproduced below.

It is submitted that the geological record, so far as we know it, suggests that there have been several creations of mammals and mammal-like forms rather than that mammals gradually evolved from reptiles.



Simpson's Genealogical Tree, showing the Origin of the Various Groups of Mammals.

It may be added that although the Triconodonta, Multituberculata, Symmetrodonta and Pantotheria are generally assumed to be mammals, owing to their known skeletal features, there is no proof of this. We do not know the nature of their integument, or whether or not they were warm-blooded or possessed mammary glands.

APPENDIX IV

SUPPOSED LINKS BETWEEN MAN AND OTHER ANIMALS

Several fossils have been cited as links between man and a lower animal. Two of these—*Hesperopithecus* and *Tetraprothomo*—may be dismissed with the remark that they are certainly nothing of the kind. The former is part of a species of peccary; the latter, proclaimed by Professor C. Ameghino as "a being more or less closely related to actual man," consists of a human atlas vertebra and the thigh bone of an extinct carnivore. Three others—*Sivapithecus*, *Dryopithecus* and *Palæopithecus*—consisting as they do merely of isolated teeth or parts of jaws, are too fragmentary to admit of exact classification; even so it may safely be said that the creatures to which they belong are not ancestors of man.

There remain four fossils from the Lower Pleistocene which require careful consideration: *Pithecanthropus*, *Sinanthropus*, *Palæoanthropus* and *Eoanthropus*.

Pithecanthropus erectus, sometimes described as the ape-man of Java, was discovered at Trinil in Java by Professor Dubois in 1891 and 1892. The deposit in which it was found is deemed by Dubois to be of the Upper Pliocene epoch; most authorities, however, regard it as very early Pleistocene. The fossil consists of a skull-cap, a thigh bone, two molar teeth, one pre-molar and a fragment of the front part of a jaw. One molar was discovered in September 1891, the skull-cap in October 1891, one metre from the tooth, the thigh bone in August 1892, fifteen metres from the skull-cap; a little later a second molar was found three metres from the skull, afterwards a pre-molar and finally, at a distance of some miles, the fragment of a jaw. The same layer contained the remains of other animals, none of which are primates.

Despite a most careful and prolonged search no further traces of *Pithecanthropus* have been found. In the circumstances it is by no means certain that all the above fragments belong to one and the same species. Excellent illustrations of these and other fossils bearing on the origin of modern man are given in Boule's *Fossil Men* (1924)—one of the best books on this subject.

The most striking features of the skull-cap are (1) its large size, (2) the ridge above the eyes like that of the skull of a gibbon or chimpanzee, (3) the forehead is very receding—more so than that of the chimpanzee, (4) the lack of a crest on the middle line, which indicates that the biting muscles were not very powerful.

The molars, which represent the right and left wisdom teeth, are not equally worn, which may indicate they do not belong to the same individual. They are considerably larger than the corresponding teeth of an orang or any known human race. They resemble the teeth of the orang rather than those of man.

The femur is about 18 inches in length and has a very human appearance; it is straight, indicating that its possessor walked upright.

It is estimated that the capacity of the skull was from 850 to 900 cubic centimetres; that of an anthropoid rarely exceeds 600 c.c.; that of the average human being of the lowest type is about 1,300 c.c., but in exceptional cases the brain capacity of a human may be as low as 1,000 c.c. Dubois made a cast of the interior of the skull in order to gain an idea of the brain it contained. The convolutions of the brain seem to have been of human type and more complex than those of the brain of the gibbon. The inferior frontal convolution is double that of a chimpanzee but only half that of a European. The frontal part of the brain—the seat of the higher faculties—is relatively small.

The above data are insufficient to serve as the basis of any definite conclusion as to the nature of *Pithecanthropus*, nevertheless Dubois exhibited in public a painted model of the living animal. Dubois regards this fossil as an ape-man representing a stage in the descent of man from an anthropoid ape. He goes so far as to assert that *Pithecanthropus* may have had a simple articulate language. Sir Arthur Keith is of the same opinion; in a lecture delivered on January 25th, 1929, he expressed the opinion that the cast taken from the skull indicates that speech was just becoming possible—primitive emotional speech, which gave vent to feeling, emotions, passion and temper, because the brain of *Pithecanthropus* is deemed to have weighed about 30 oz., which Keith considers to be the minimum weight compatible with human speech. In his article on Man in the *Encyclopædia Britannica* Keith says that Dubois by his discovery has "caught the human brain in the act of evolving."

Keith and Dubois believe that the femur and the skull-cap belong to the same species; if this be correct it follows, on the evolution theory, that man acquired his upright gait before his brain became human.

If the teeth and the skull-cap belong to the same species, this must have been a very big primate, which, even if an ape, should have a brain larger than that of any living anthropoid. This, taken in conjunction with the poor development of the front part of the brain, seems to indicate *Pithecanthropus* was merely a large anthropoid ape, which is the opinion of Boule and some other authorities.

Sinanthropus, or the Pekin man, was discovered in 1929 and 1930 near Pekin in what is confidently asserted to be a Lower Pleistocene formation. This genus is at present known to us by two more or less perfect skulls, fragments of two skulls, parts of two jaws and six teeth. From the situations in which they were found it is believed that these fossils represent ten individuals.

The only well-known authorities who up to this time (November 1930) have examined this fossil are Dr. Davidson Black and Professor Elliot Smith. The teeth are said to be undoubtedly human. Black considers the skull found in 1929 to be that of a woman and the 1930 skull that of a young man. In a letter to *The*

Times of April 15th, 1930, Elliot Smith makes the following comments on the skull of the female: The jaws exhibit features like those of *Eoanthropus* (the Piltdown skull), but "the whole architecture of the part of the skull surrounding the ear differs profoundly" from that of *Eoanthropus*.

> "In *Sinanthropus* we have a condition of affairs which much more closely resembles that found in the gorilla and chimpanzee than in any known human skull. The skull is definitely thicker than that of modern man, although it does not attain the phenomenal thickness of the skull of the Piltdown man. . . . While the Pekin man presents features analogous to those of *Pithecanthropus* and Neanderthal man, he belongs to a genus which is definitely distinct from both, but approximates more nearly to his Javan contemporary, *Pithecanthropus*, than to his relatively recent successor, Neanderthal man. His brain case is definitely bigger than that of *Pithecanthropus*, but the features of the base of the skull (which unfortunately are unknown in the case of *Pithecanthropus*) display startling Simian characters which suggest a close affinity between the most primitive members of the human family and the anthropoid apes of Africa."

The skull of the young man was discovered after Elliot Smith had left China. Black reports that the brain case is not so thick as that of the woman, and the frontal eminences are less prominent, the root of the nose is broad and flat and quite unlike that of the Piltdown man, the jaw sockets are massive, suggesting marked biting capacity.

In the opinion of Black *Sinanthropus* is pre-Neanderthaloid, not far from the type from which evolved both Neanderthal man and *Homo sapiens*.

It should be noted that these remarks are made in the absence of all knowledge of any parts of *Sinanthropus*, except the skull, jaws and teeth.

Palæoanthropus or *Homo Heidelbergensis* appears to have been more or less contemporaneous with *Pithecanthropus* and *Sinanthropus*. This fossil consists merely of a lower jaw found near Heidelberg. It is very massive and devoid of a chin, in which respects it resembles the jaw of an anthropoid ape; it also exhibits features similar to those of the jaw of an Old-World monkey; on the other hand, the teeth have a human appearance. Boule deems this jaw to belong to a species of man, others regard it as intermediate between that of a man and that of an ape.

Eoanthropus or *Homo dawsoni*, like *Pithecanthropus*, was found piecemeal at Piltdown in Sussex. It appears to have been more or less contemporaneous with the three forms we have just noticed. It consists of some fragments of a skull, the right half of a lower jaw and a tooth. These were all found in the same locality, but the find was spread over a period of several years.

After piecing together all the fragments of the skull there is still a considerable part of the middle of the brain case wanting, hence the brain capacity of the skull can only be guessed. Some put it as low as 1,070 c.c., others as high as 1,500 c.c.

Apart from its great thickness the skull is human in appearance, and the supra-orbital ridges are not more greatly developed than in modern man. The jaw, however, bears a strong resemblance to that of a chimpanzee. Boule and others think that the skull is that of a man but the jaw belongs to a chimpanzee. In this connexion it should be noted that in the layers from which the above fossils were unearthed flints have been discovered which appear to have been chipped by the hand of man to make rude implements such as hammers and scrapers, indicating that human beings existed in the Lower Pleistocene epoch which corresponds to the Chellean period of archæologists.

The above are the only known fossils of the Lower Pleistocene or any earlier period that can possibly be deemed human.

From the middle of the Pleistocene onwards, however, human fossils are abundant.

In the Middle Pleistocene, known to archæologists as the Mousterian period, lived a race of men of which the implements were of bone and stone and were more skilfully made than those of Chellean man.

This race, which is called the Neanderthal man, is known by a number of fossils, some of which consist of complete skeletons.

The Neanderthal man, whose average height appears to have been only about 5 ft. 1 in., had a relatively large brain; the cubic capacity of this was about 1,450 c.c., the average of that of an Australian native being 1,340 c.c., of an African negro 1,477 c.c., and of a European 1,550 c.c.

Boule would discount the size of the brain of Neanderthal man by asserting that, judged by the interior of the brain case, his brain exhibited simian features. With this Symmington disagrees. Boule also considers that the skeletal structure of Neanderthal man is such that "without being mechanically impossible, the total extension of the knee could not have been normal, and the habitual attitude must have been one of semi-flexion." Vialleton challenges this on the ground that the shape of the hip-bone of Neanderthal man indicates an upright gait.

The chin is far less pronounced than that of living man; the forehead is much lower and the orbital arches far more greatly developed, so that Neanderthal man must have had a rather brutish mien; on the other hand, his nose was better developed than that of modern man; in this respect he must be regarded as ultra-human.

Neanderthal man seems to have disappeared before the end of the Pleistocene, for in the later part of this epoch he was replaced by a very different type—the Cro-magnon, a race of *Homo sapiens.*

It should be mentioned that fossils have been found of another race of *Homo sapiens*, the Grimaldi man, who seems to have lived during the later part of the Chellean and the early part of the Mousterian period. The Grimaldi man was probably a negroid type.

The Cro-magnon man seems to have been both physically and intellectually on a par with living man, and he differs so greatly from the Neanderthal man whom he supplanted that it does not seem possible for him to have evolved from the last.

The above facts are not easily accounted for on the evolution theory. None of the fossils we have considered can have been the ancestor of any other; Heidelberg man, however, *may* have given rise to Neanderthal man.

If Keith and Dubois be right in believing that in *Pithecanthropus* we see the human brain in the process of evolving, then, as *Pithecanthropus* cannot have given birth to *Sinanthropus*, Neanderthal man or Piltdown man, the human brain must have evolved independently on at least four occasions, or three if we accept Black's view that *Sinanthropus* is a cousin of some human from which evolved both Neanderthal man and Piltdown man; but this seems improbable, because *Sinanthropus* appears to have been a contemporary of Piltdown man, and, by the Upper Pleistocene, *Homo sapiens* had not only evolved but become differentiated into three well-marked races—Cro-magnon, Grimaldi and Chancelade. If all these, together with Neanderthal man, evolved from a common human ancestor, that ancestor must have lived long before the Lower Pleistocene, and it is most surprising that no fossils have been found throwing light on the supposed evolution of the above three races of *Homo sapiens*. Their fossils are abundant, but not one is known linking any of them with a hypothetical human ancestor.

Thus, so far the only assistance palæontology has given to the theory that man gradually evolved from some non-human ancestor is that it tells us that in the past there existed anthropoids more highly developed than any now living, and races and genera of man that have become extinct. In some features these early humans were more ape-like than living man is, but in a few they seem to have been less ape-like.

Owing to lack of fossil evidence of man's supposed evolution zoologists are reduced to guessing at his origin. Various guesses have been made: that he evolved from some anthropoid ape, that the human line branched off from the primate stock almost simultaneously with the anthropoid ape line, that the human line branched off from some Old-World monkey, that it branched off from a very early tarsioid stock.

This last view is that of Professor Wood Jones, who has elaborated his theory in *Man's Place Among the Mammals* (1929).

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